CIVIL ENGINEERING

Putting More Sense into the Construction Dollar—White, Tompkins, Bloodgood, Reynolds

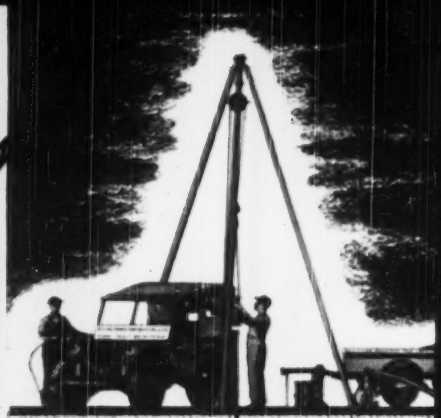
Four Contractors Combine to Build UN Secretariat in Heart of New York—Crandall

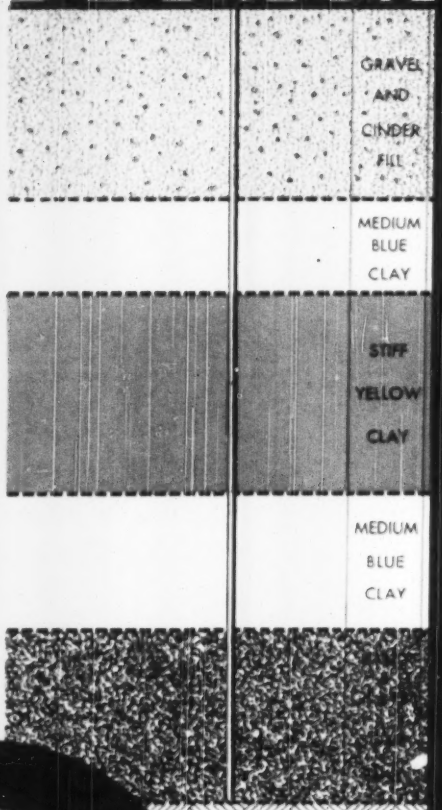
PROCEEDINGS Papers Become Separates—see Society News for Summaries

Avoid foundation risks

SPECIFY GOW SOIL BORINGS BY Raymond

...and be sure!



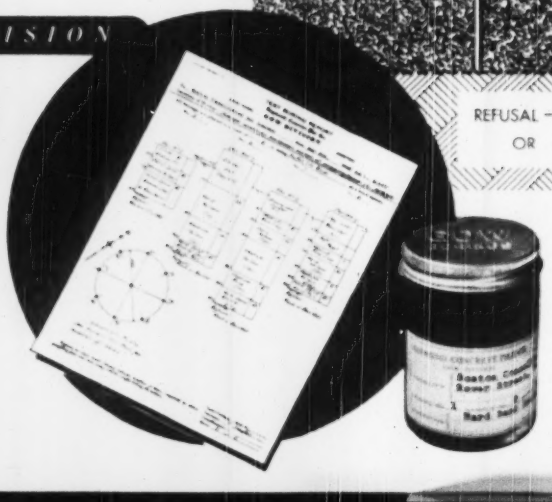


Gow subsoil investigations are insurance against costly foundation errors, especially when the borings are made before the site is purchased.

Usually, Gow exploratory borings are sufficient for ordinary foundation investigations. If special samples are required for laboratory analysis, our Gow Division is equipped to secure such samples, either by the Shelby-tube method, or with other types of samplers. Where necessary, rock cores are recovered by diamond drilling.

The report you receive from our Gow Division is complete and authoritative and will furnish the basis for sound engineering decisions.

THE SCOPE OF RAYMOND'S ACTIVITIES includes, in addition to borings for soil investigation, every recognized type of foundation construction—concrete, composite, precast, steel, pipe and wood piles. Also caissons, underpinning, construction involving shore protection, shipbuilding facilities, harbor and river improvements, and cement mortar lining of pipes by the Centriline Corporation, a Raymond subsidiary.



Figures in right-hand column indicate number of blows required to drive sampling pipe one foot, using 140 lb. weight falling 30 inches

GOW DIVISION

Raymond

CONCRETE PILE CO.

140 Cedar Street, New York 6, N. Y.

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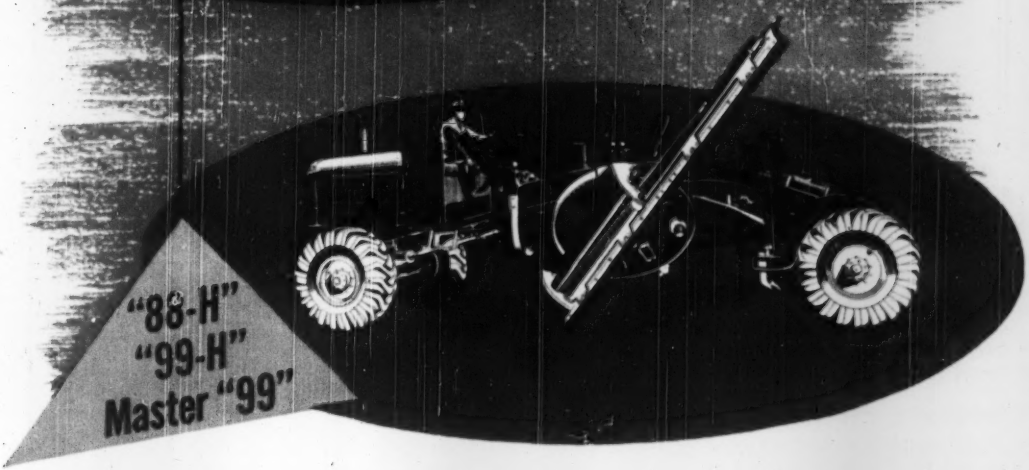
All-Wheel Drive and Steer — [illegible] — Full Hydraulic Control

FOR ALL-WHEEL DRIVE
AND ALL-WHEEL STEER



"88-H"
"99-H"
Master "99"

With All-Wheel Drive, there are no idling front wheels—no dead front end to consume power and decrease operating efficiency. All weight is on driving wheels—front and rear—contributing 100% to traction and utilizing the full power of the engine.

All-Wheel Steer provides unequalled maneuverability; saves time on every job; makes it possible to work in places where ordinary motor graders cannot go—do things they cannot do.

Yes, there is *no substitute* for All-Wheel Drive and All-Wheel Steer in a motor grader . . . no way in which any rear drive, front steer machine can equal the maneuverability, power-at-the-blade, and all-around performance of an Austin-Western "88" or "99."

Get the complete story of the many additional features of these outstanding graders from your A-W distributor, or send for the latest bulletins.

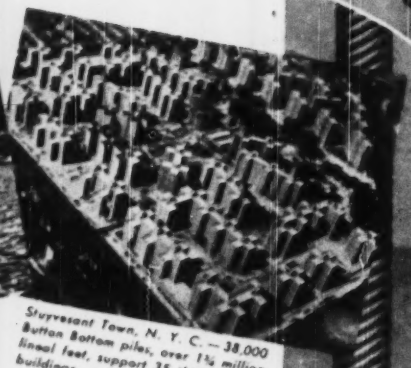
AUSTIN-WESTERN COMPANY, AURORA, ILLINOIS, U.S.A.

CIVIL ENGINEERING, February, 1950 — Vol. 20, No. 2 — Published monthly by the American Society of Civil Engineers — Publication office 20th and Northampton Streets, Easton, Pa. — Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. — Price $60 a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. — Canadian postage 75¢ and foreign postage $1.50 additional. — Entered as second class matter September 23, 1950, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

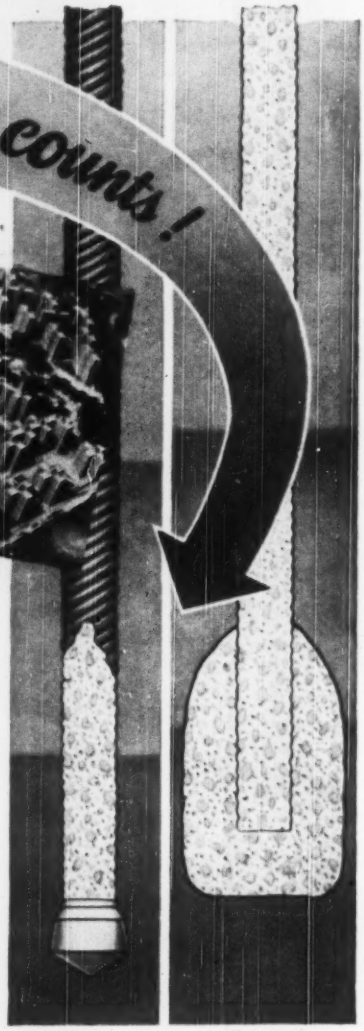
CYLINDRICAL PILES CARRY BIGGER LOADS BECAUSE THEY ARE

BIG *Where it counts!*

Marathon Paper Company's pulp mill, Ontario, Canada—rests securely on Western's Pedestal piles.



Stuyvesant Town, N. Y. C.—38,000 Button Bottom piles, over 1¼ million lineal feet, support 35 thirteen-story buildings.



Left, Button Bottom pile; right, Pedestal pile. The enlarged bases provide high carrying capacities.

BIG WHERE IT COUNTS, WESTERN'S Button Bottom* and Pedestal* piles distribute their loads over a greater area in the dependable strata to develop full carrying capacity.

WESTERN'S CYLINDRICAL PILES—full diameter for full depth—penetrate poor bearing strata to reach dependable soils below. Their large circumferential and cross-sectional areas give higher load capacities, both frictional and end-bearing.

WESTERN HAS SUCCESSFULLY MET THE PROBLEMS posed by every type of site, soil, and load condition for over 25 years. No job is too big, no job too tough. For prompt, expert advice discuss your foundation problem with a WESTERN engineer. Catalog B, with illustrations and descriptions of WESTERN piles, will be sent upon request.

See our CATALOG in SWEET'S FILE

*Patented

FOUNDATIONS FOR INDUSTRIAL PLANTS, POWER PLANTS, BRIDGES, PIERS AND DOCKS, AIRPORTS, STEEL PLANTS, HOUSING PROJECTS, COMMERCIAL BUILDINGS, SCHOOLS, ETC.

BUTTON BOTTOM PILES • COMPOSITE PILES • PEDESTAL PILES • CAISSON PILES
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WESTERN FOUNDATION CORPORATION

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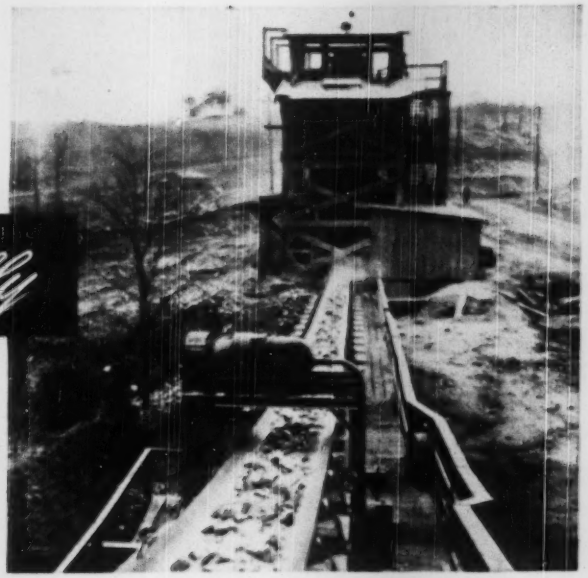
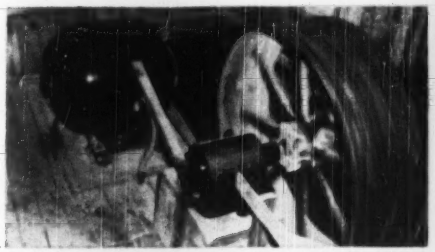
turning granite into sand...

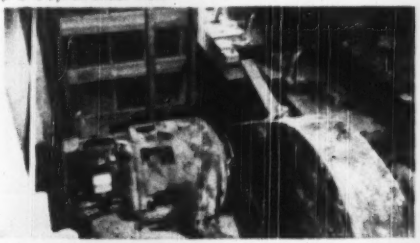
...Electrically



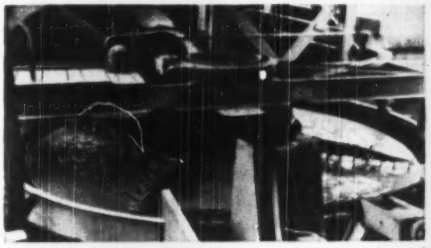
Rock coming from secondary crusher is carried on conveyor driven by a 50-hp G-E gear-motor



Crushed rock is reduced to sand in Marcy rod mill made by The Mine & Smelter Supply Co., Denver, Colo. Drive is a 350-hp G-E synchronous motor



50-hp G-E motor powers conveyor belt hauling material to hopper at top of cement mill



Dorr classifier, for washing sand clean and removing dirt and fines, is powered by a 3-hp G-E gear-motor

Aggregate Plant at Clark Hill Depends on G-E Driven Equipment To Maintain High-Speed Production

It takes rugged, dependable equipment—with rugged, dependable drive—to turn out 450 tons of aggregate per hour, 24 hours a day, as the high-speed plant at Clark Hill is doing. That's why Allstates Constructors, Inc.—a team of six contractors led by Walsh Construction Co.—is relying on *electric drive* to keep the crushers, rod mill, conveyors, and sand classifiers on-the-job, all the time.

Contractors and machinery manufacturers alike are finding that the greater dependability of electric drive means *greater profits.* And when they use G-E drive, expert engineering assistance in application, installation, and service is always available to them—wherever the job may be.

Ask him Today!

Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.

GENERAL ELECTRIC

3 important reasons for building with

CONCRETE FRAMES AND FLOORS

REINFORCED concrete frame and floor construction offers three important advantages to architects, engineers, contractors, owners of privately financed buildings or taxpayers who pay for public buildings:

1. It reduces construction costs substantially. Concrete construction can lower frame and floor costs 25% to 40% under other types of construction.

2. It saves construction time. Since frame and floor construction proceed simultaneously, masons, plumbers, electricians and other tradesmen can do their work as the structural job progresses.

3. It allows great latitude in design. Partitions can be located where they are most desirable and columns can be placed wherever convenient to leave maximum usable space. Regardless of structural requirements there is a type of concrete frame and floor construction for every job. Such construction is ideally adapted to apartments, hospitals, schools, hotels, industrial plants and office buildings.

A typical example of concrete frame and floor construction is Fordham Hill Houses illustrated above. This project, owned by the Equitable Life Assurance Society of the United States, consists of six 16-story, two 15-story and one 14-story building.

This 1,118 apartment development in New York City required more than 40,000 cu.yd. of concrete in the frames and floors—enough to build an average 24-ft. highway about 13 miles long. Leonard Schultze and Associates, architects; J. DiStasio & Co., structural engineers; Starrett Bros. & Eken, contractors, all of New York City.

Our technical staff will gladly help architects and engineers attain the highest quality concrete and the maximum structural advantages of reinforced concrete construction for any building project.

Write for two free booklets, "*Continuity in Concrete Building Frames*" and "*Handbook of Frame Constants.*" Distributed only in the U.S. and Canada.

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A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

Which One is You ?

type one

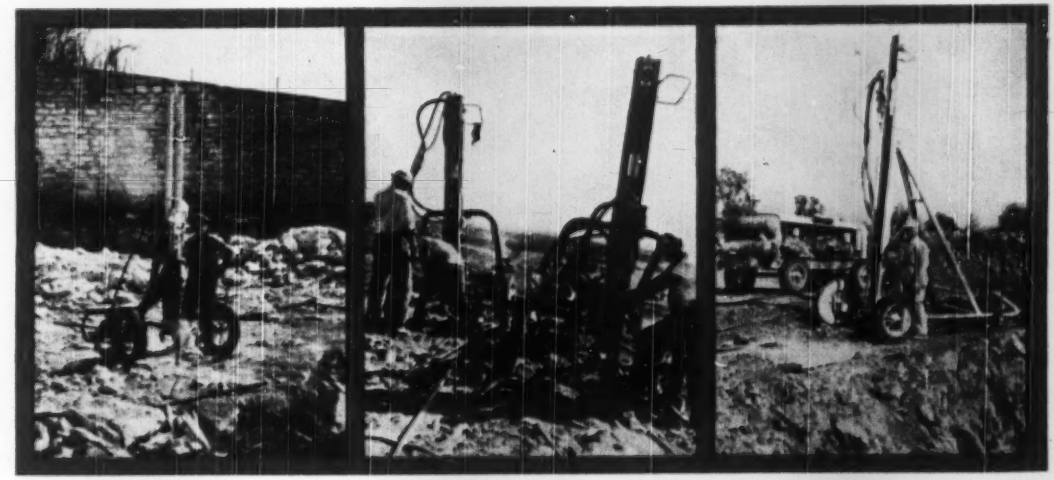
Do you drill holes all over the lot? A few in this cut—a few for that footing? Then you'll choose the lightweight LCM—the ideal wagon drill for use where moves are frequent.

type two

Do your jobs call for fast drilling? Big footage on every shift? Then you'll want the universal URM—for the last word in wagon drill efficiency and performance.

type three

Do you run into a lot of heavy rock excavation—with cuts up to 40 feet deep? Then the Gardner-Denver WD is the wagon drill for you. It's specially designed for deeper holes.



LCM FEATURES:

Lightweight—easy to move
Positive feeding pressure
Convenient feed and drill controls
Highly maneuverable
Equipped for 6-foot steel changes

URM FEATURES:

Simple, responsive controls
Maintains correct bit pressure
Positive, effortless blowing
Adjustable wheels and mast
Handles 6-foot steel changes

WD FEATURES:

Extra powerful blowing
Pneumatic feed
Power operated mast
Adjustable to any position
For 10 or 15-foot steel changes

Whether your drilling pattern fits Type 1, 2 or 3—choose a Gardner-Denver Wagon Drill for faster, easier drilling. Write for Bulletin WD-1.

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Drainage dollars cover more ground when you use Armco Corrugated Metal Structures. Here's why.

There's a type and size for every need from a 6-inch round pipe to a 24-foot MULTI-PLATE Arch. You save in handling and hauling because Armco Structures are light in weight and often can be nested to save space.

Installation is economical, too. Long lengths of Armco Pipe mean fewer sections to lay, line and join. Simple band couplers assure speedy, positive connections. Jobs go fast with just a small crew. No special tools are required.

And here is something else. Nearly half a century of underground service proves the lasting economy of Armco Corrugated Metal Structures. They have ample strength and durability to serve for years with little or no maintenance.

Let us show you how easy you can save time and money on that next job. Call or write today. Armco Drainage & Metal Products, Inc., 3370 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation.

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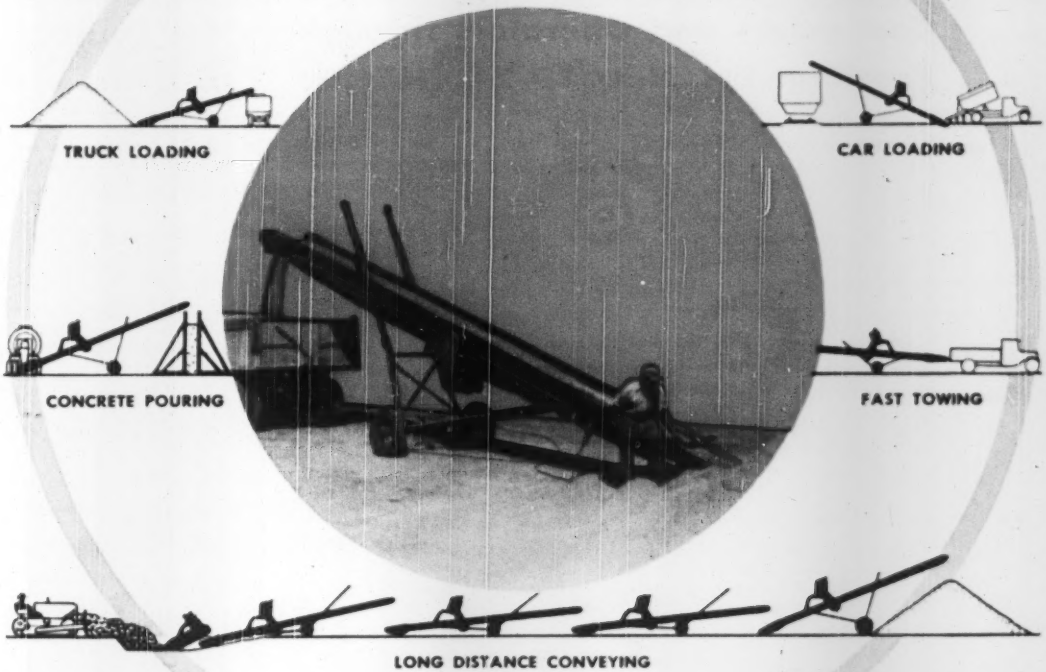
ARMCO

ARMCO DRAINAGE STRUCTURES

Barber-Greene

ALL-PURPOSE, ALL-MATERIAL PORTABLE CONVEYORS



VERSATILE • LOW COST • ONE-MAN OPERATION

These highly useful Barber-Greene Conveyors can help you load, unload and transfer all classes of bulk materials or packaged goods faster, at lower cost and *with a smaller labor force*. Easy to tow to and from the job, they are quickly set up and operated by one man. They are truly *all-material* conveyors: They set new standards of efficiency in handling stone, sand, gravel, coal, coke, ashes, bulk chemicals, bagged or boxed material—even wet concrete. Available in many sizes (lengths from 25′ to 60′; belt widths from 18″ to 30″) with advanced features that include full swiveling pneumatic-tired wheels, lighter, stronger frames, V-belt drives and antifriction bearings. Gasoline, electric, or Diesel power.

Get full information from your nearest Barber-Greene Distributors, or write Barber-Greene Company, Aurora, Illinois. Cable address: "Bargreene." Barber-Greene Company, 642 West Park Ave., Aurora, Ill.

BARBER • GREENE COMPANY AURORA, ILLINOIS

Constant flow Equipment

CHAMPION of

Contractors and Operators throughout the Country Proclaim the New TD-24 CHAMPION of Crawlers

The International TD-24 has proved itself CHAMPION of Crawlers. On job after job, the new TD-24 has won the admiration of operators for the ease with which it does work which other tractors cannot do. Contractor-owners are equally enthusiastic, for they see the TD-24 outworking and out-producing every other tractor in the field.

Greater power, and the weight and traction to match, plus new operator convenience and ease of control, give the TD-24 much more than an edge over any other tractor you might name.

Experienced operators and owners have this to say about the new TD-24: (names on request)

"In my estimation the TD-24 is the heavyweight champion of crawler tractors."

"The TD-24 works right along on slopes so steep we have to cut them down before other tractors can even navigate unloaded. TD-24's are fast tractors, easy to shift and have plenty of power. This combination really moves dirt . . . made us more money than any other tractor could."

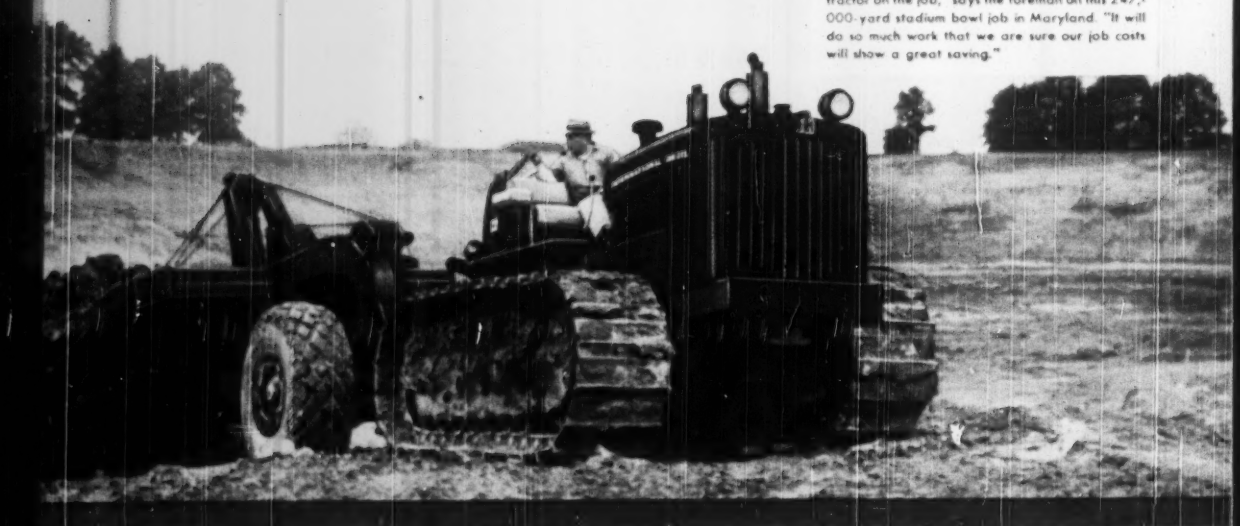
"The TD-24 is a wonderful piece of machinery and I can't say enough for it. Our operators feel they are wasting their time when they run other tractors, for no other tractor built can compare with the work these TD-24's can do."

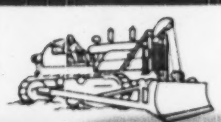
Visit your International Industrial Power Distributor and see what the TD-24 can do for you. You'll agree it's the CHAMPION of Crawlers—the one tractor you can't afford to be without, for profitable earthmoving.

INTERNATIONAL HARVESTER COMPANY
Chicago

JOB FOREMAN REPORTS SAVINGS

"It (the TD-24) is definitely outhauling every other tractor on the job," says the foreman on this 247,000-yard stadium bowl job in Maryland. "It will do so much work that we are sure our job costs will show a great saving."





Crawlers

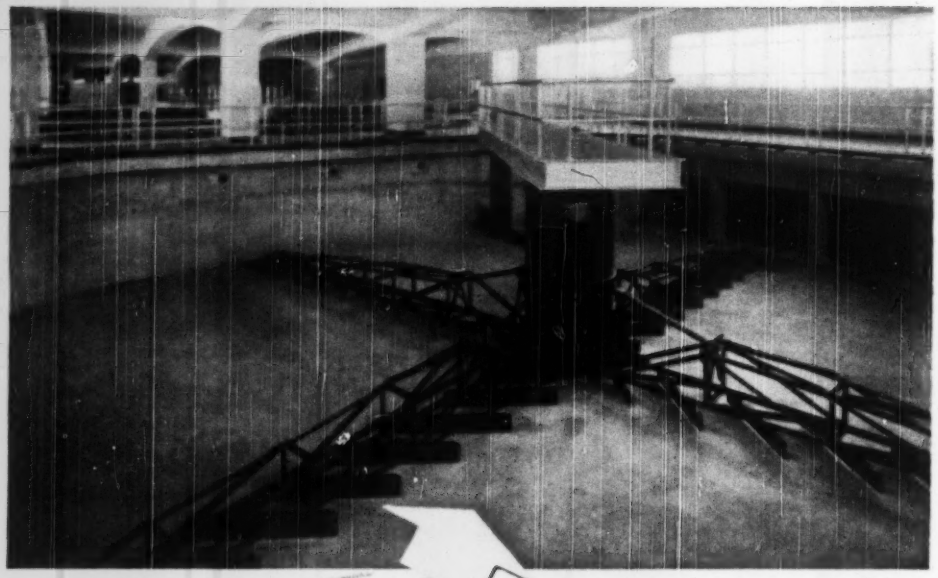
"Worth Two of Any Other Heavy Tractor," says Lindsey Belville, president of Greasy Ridge Coal Co., Greasy Ridge, Ohio, strip mine. "This is the best tractor I've ever used in my five years experience," says Warren Bare, the tractor operator shown working it in heavy rock. "It is the only one that will do everything I want it to," he claims.

INTERNATIONAL HARVESTER

INTERNATIONAL
INDUSTRIAL POWER

CRAWLER TRACTORS • WHEEL TRACTORS • DIESEL ENGINES • POWER UNITS

IN GRIT CHAMBER DESIGN



it's the AREA that counts!

Why is area important?
Because without sufficient settling area, no grit chamber can remove enough of the plus 65 mesh sand and inorganics that cause trouble in most sewage plants. This has been proven conclusively by research and field tests.

What unit provides sufficient area?
The Dorr Detritor, designed on an *area* basis, will mechanically remove and wash 95% of plus 65 mesh material . . . under maximum flow conditions . . . regardless of feed composition. Coarser or finer separation are possible if required.

Dorr Detritors have these plus benefits!

No overloading or stalling . . . the grit collecting mechanism has hinged, torque-actuated arms, which automatically raise and work off peak loads of grit.

Long Life . . . maintenance is negligible . . . all bearing and wearing parts are above water . . . abrasive action from grit and sewage is completely eliminated.

Produces a drained and washed grit containing not more than 3% by weight of putrescible organics . . . eliminates any odors, unsightliness or septic action.

* * *

Dorr Detritors are available in two types and a variety of sizes to fit the largest or smallest plant requirements. If you have a grit removal problem, write for a complete technical reprint on design factors in grit removal and washing.

DORRCO

THE DORR COMPANY, ENGINEERS
BARRY PLACE, STAMFORD, CONN.
NEW YORK • ATLANTA • TORONTO
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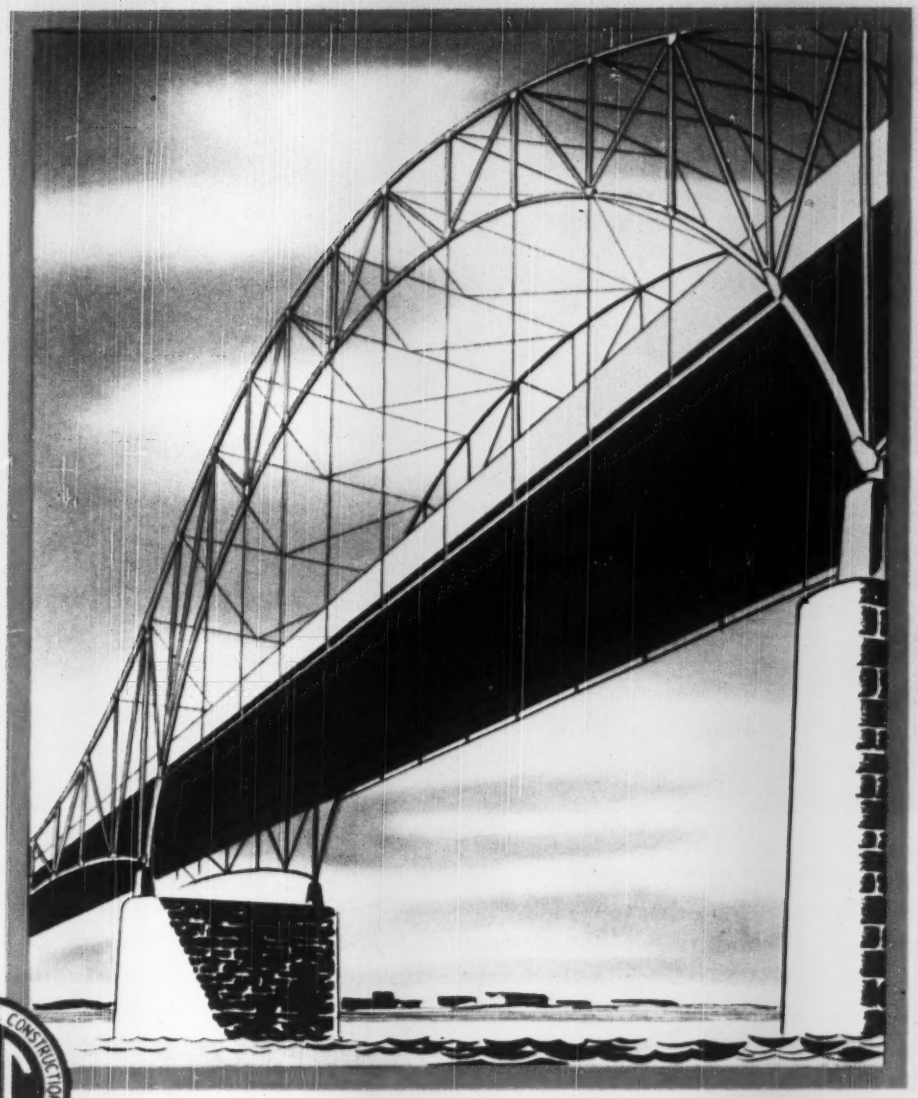
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.

DORR

RESEARCH — ENGINEERING — EQUIPMENT



AMERICAN INSTITUTE OF STEEL CONSTRUCTION INC. AISC FOUNDED 1921

"Steel Permits Streamlining Construction With Safety, Endurance and Economy."

FORT PITT BRIDGE...

builds the New Elizabeth Bridge

When completed, the new Elizabeth Bridge—spanning the Monongahela River a few miles above Pittsburgh, Pennsylvania—will be an excellent example of the real beauty and dependability that only a STEEL BRIDGE can provide.

Fort Pitt BRIDGE WORKS

Member American Institute of Steel Construction

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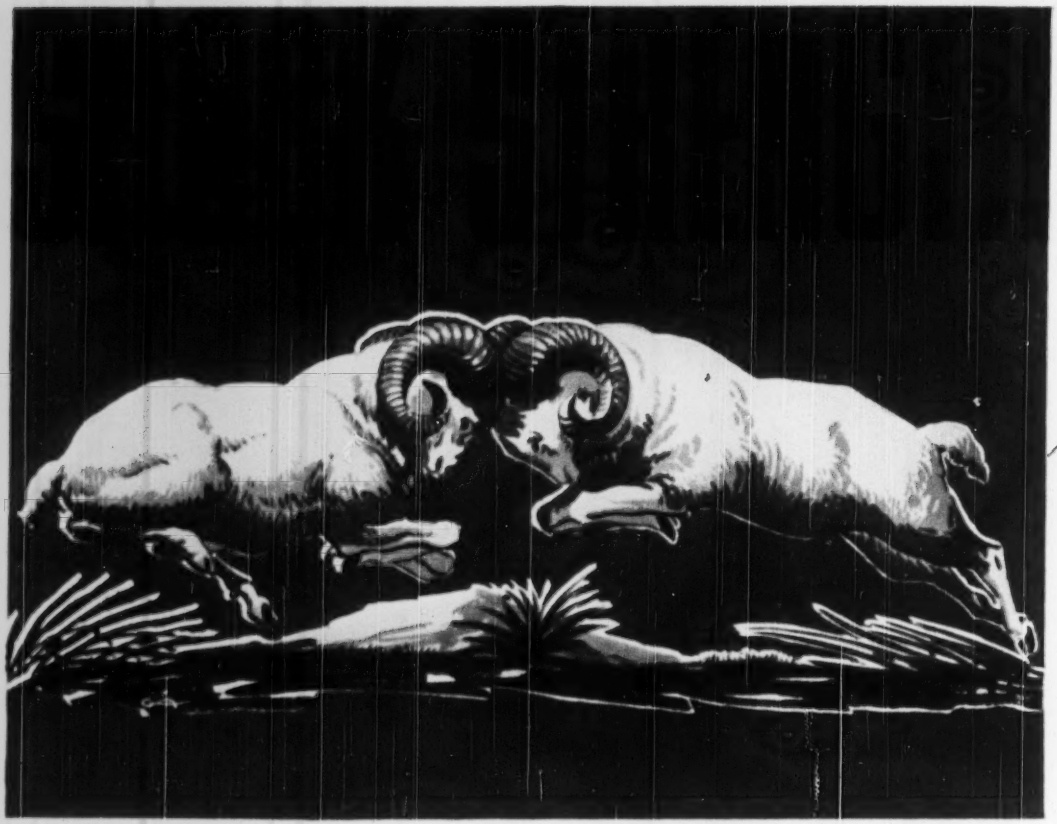


Without shock strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE

Strength factors of Long Life !

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

CRUSHING STRENGTH

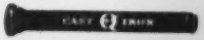
The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

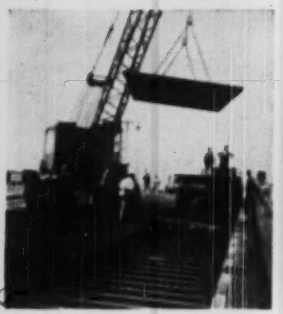
BURSTING STRENGTH

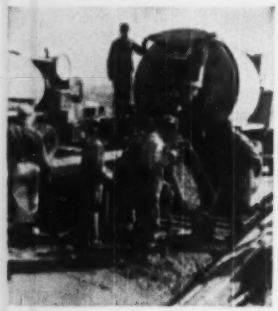
In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

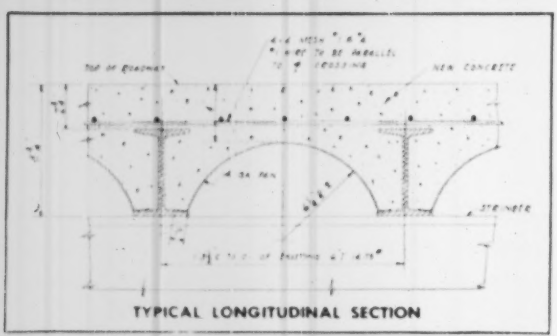


SERVES FOR CENTURIES

'INCOR' CONCRETE REPLACES GRID BRIDGE-DECK ON LONG ISLAND CITY APPROACH TO NEW YORK'S QUEENS-MIDTOWN TUNNEL







TYPICAL LONGITUDINAL SECTION

MIDTOWN Elevated Express Highway carries 11-million vehicles a year to and from Queens-Midtown Tunnel. Where this Highway crosses high above Dutch Kills, the steel-grid bridge-deck was hazardous when wet or icy—sand and salts fell through. For safety's sake, the City's DEPARTMENT OF PUBLIC WORKS decided to rebuild the deck with concrete.

EDGECLIFF CONSTRUCTION CORP., of Long Island City, rebuilt a lane at a time, to minimize motorists' inconvenience. Removing the grid sections, total 52 ft. by 1040 ft., required cutting 56,000 welds. Grids were lifted by crane, then permanent metal-pan forms were inserted between transverse I-beams, and mesh-reinforcing and concrete placed.

For durability and wear-resistance, and because much of the work was done in cold weather, 'INCOR'* AIR-ENTRAINING 24-HOUR CEMENT was used throughout. Gaining service strength in a fraction of the usual time, 'Incor' minimized freezing risk in this highly exposed location, where heat protection was out of the question.

Motorists were quick to notice the sure-grip of concrete under wheel. Further proof of the axiom that traffic safety *begins* with the pavement!

Reg. U.S. Pat. Off.

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What can research do for a specification product?

We manufacture a "specification" product—cast iron pressure pipe. It is purchased under standard specifications set up by engineering organizations representing users of the product, consultants and manufacturers. Meet the specifications and the customer is satisfied. The question is whether the manufacturer should be satisfied.

About 20 years ago we decided to find out what research could do for a "specification" product. The function of Industrial Research was then, as it is now, to develop a better product at the same, or if possible, at lower cost. We built and equipped a Research Laboratory.

What research has since done for our product is a result best known to our customers!

After all, specifications only establish a "floor" beneath which quality standards must not fall. Through research we have steadily elevated those standards and, through quality control, have seen to it that they are adhered to.

Progress made by individual companies eventually leads to higher standards which must be met by all makers of the product. And progress in the production of cast iron pressure pipe is important to water, gas and sanitation utilities as well as to the public they serve. The key to such progress is Research.

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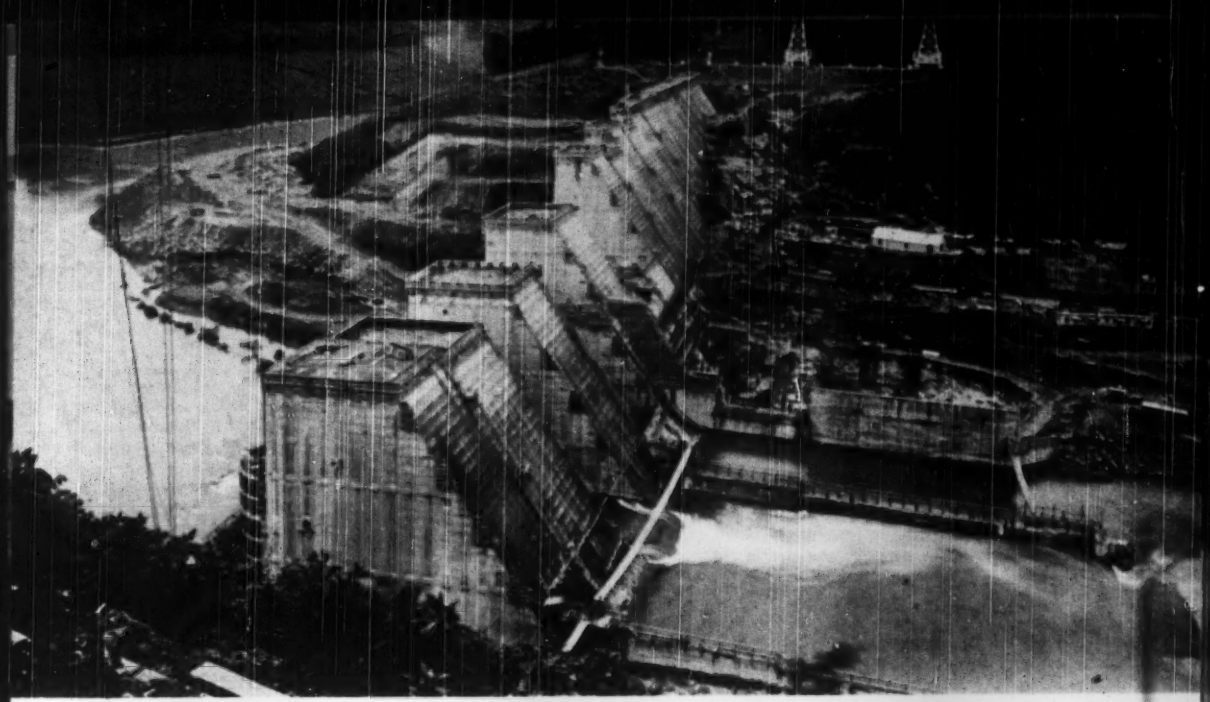


SEVERAL MONOLITHS of Norris Dam on Clinch River, Tennessee, were left low to permit economical river diversion. No damage to structure resulted although this practice is now banned in specifications for large concrete dams. Completed in 1936, Norris Dam has height of 265 ft, length of 1,860 ft and volume of 1,184,000 cu yd.

Putting More Sense Into the Public Construction Dollar

ENGINEERING CONTRACTORS and government engineers exchanged views on stretching the construction dollar of public agencies in a town-meeting type of conference at an Annual Meeting session of the Construction Division. Two types of construction were treated in detail—large dams and public buildings. Engineering contractors Ross White and Francis Tompkins, believing that today, in both training and ethics, designing engineers differ little from the engineers in contracting organizations, contended that specifications should give wider latitude to contractors to use their experience and ingenuity on the construction entrusted to them without the monitoring of every step. Engineers Grant Bloodgood and W. E. Reynolds, in responding for Government agencies, stated that recent simplification and standardization of designs and specifications, and improved relationships between engineers and contractors, are keeping costs down in spite of rising prices of materials and labor. They pointed out ways in which objective professional consideration of both viewpoints on problems of design, specification writing, and supervision, have already helped price-conscious builders of public works to get more out of the construction dollar.

Common Sense Can Promote Economy in Dam Construction

ROSS WHITE, M. ASCE
Vice-President, Brown & Root, Inc., Houston, Tex.

ONE DEFINITION of the engineer which was current some years ago stated that "The engineer is a man who can do well with one dollar what any one can do after a fashion with two dollars." In recent years it has sometimes seemed that in his effort to "do well," the engineer has forgotten the second part of the definition. Study and research in field and laboratory are constantly developing new materials and methods. The engineer would not deserve his title if he ignored these developments. But he is equally undeserving of the title if in the search for perfection he ignores economy and common sense. In the case of some modern practices, the results achieved do not seem to justify the extra cost.

One of the most criticized of these practices is that of refrigerating concrete, both before and after placing. This practice is especially open to question in the case of structures which in size and character are in no way out of the ordinary. The cost of such refrigeration is not trivial; it may increase the cost of a

NO ARTIFICIAL COOLING, over 200-ft difference in elevation between adjacent monoliths, and high-speed placement marked construction of Morris Dam, yet it is one of very few "bottle-tight" dams in the world. Completed in 1934, on San Gabriel River, California, dam is 328 ft high, 780 ft long and has 446,000-cu yd volume.

large modern dam by millions of dollars. What is gained by the extra expenditure? Greater safety? No. Greater durability? Very doubtful. A more useful structure? No. Fewer cracks? Perhaps. What properly designed mass concrete dam has ever failed because of temperature cracks? Or been a less useful structure? Or caused any but the most trivial additional maintenance or operating cost? The answer to all these questions is, none. Then why should these tremendous sums be spent on construction requirements that in no significant way affect any of the purposes for which dams are built?

Specification writers have increased costs without any corresponding improvement in the structure by specifying the use of certain equipment and forbidding the use of other equipment. An example is the banning of belt conveyors for transporting concrete. Hundreds of thousands of yards of first-class concrete have been passed over belt conveyors, but in spite of a specification giving the engineer unlimited power to condemn and order removed any concrete which does not come up to specifications, the use of the belt conveyor for transporting concrete is forbidden. Building a large concrete dam is primarily a problem in materials handling, and a belt conveyor is one of the best and cheapest tools for such handling. Many bids would be lower, without impairment of quality, if this useful tool were not banned.

Why Specify Bucket Size?

Some specifications forbid the use of buckets of more than 4-cu yd capacity in placing concrete. Very little evidence is available that there is any difference whatever in the quality of concrete conveyed in an 8-cu yd bucket as compared with that carried in smaller buckets. Handling costs, however, are in almost inverse ratio to the size of the units. Powerful modern vibrators can compact 8 cu yd of concrete just as effectively as they do smaller units.

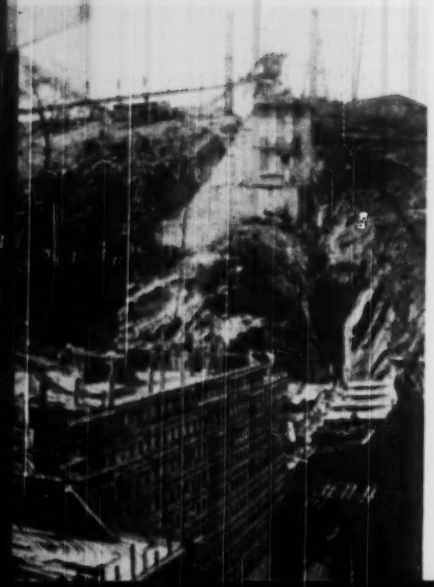
Clean-up of horizontal surfaces between lifts in mass concrete work is now one of the major items of cost, but it is extremely doubtful if proper value is being received for the outlays made. Many tests have shown so little difference in bond between sand-blasted surfaces and those simply washed off that this is suggested as a fruitful field for construction economy. If mass concrete were still being sluiced into place through chutes as it was in the late teens and early twenties of this century, there would be reason for a rigid clean-up specification.

Selection of Aggregates

Common sense and economics are also needed in the selection of aggregates for concrete. It would be a rash engineer indeed who would select the aggregate for any major structure in an unknown area without taking advantage of every test possible. Once the tests are made, however, common sense should tell the engineer that he need not worry about resistance to freezing and thawing for a structure in Florida or south Texas, or about lack of abrasive resistance for aggregate going into a cutoff wall to be buried a hundred feet under an earth dam. Common sense should also tell him that if concrete made from a certain aggregate has stood up for many years under identical exposure conditions, it is good aggregate regardless of laboratory tests.

Such reasoning is sometimes disregarded. If a natural sand of good quality is available, thinking should go beyond the laboratory before it is rejected in favor of the much more costly manufactured sand just because it is not "kinsfolk" to the coarse aggregate available. Maybe surface repairs, after a century or so of weathering, would be far less costly than the capitalized cost of artificial sand. Thought should be given also to the possibility that the structure may be obsolete long before it deteriorates enough to be dangerous.

In building mass concrete dams, another field deserving careful review and study is that of revising the practice of specifying shallow lifts, and long delay between pouring such lifts. Earlier practice usually permitted the monoliths to be placed as rapidly as the plant of the constructor allowed. This practice is still common among our neighbors to the North. Under many conditions, permitting a monolith to be built nearly continuously would result in great construction economies.



DON PEDRO DAM, California, has been in use over 25 years (since 1923) without trouble, yet almost every rule of modern technology was violated in its construction. Today's specifications would have doubled cost of this structure, which is 284 ft high, 1,040 ft long and contains volume of 296,600 cu yd. Construction view shows north half of dam, from upstream.

not the least of which would be the entire elimination of costly clean-up and curing at frequent intervals. Further economics frequently would result from the more continuous use of construction plant and earlier completion of the structure.

Variations in Height Between Monoliths

Along with permission to build single monoliths as rapidly as economics justifies should come the elimination of requirements that the dam be brought up with only small variations in height between adjacent or all monoliths in the whole structure. Many high dams have been built to their full height in one section before any concrete was placed on the foundation of an adjoining section. No failure in any of the purposes for which dams are built has ever resulted from this practice.

A slight change in layout, such as leaving one or two monoliths of a dam free of gates, for use in river diversion, may mean major economies.

It may be stated that omitting refrigeration, permitting large diferentials in height between blocks and rapid pours, will result in cracks in the dam. In the language of the street, the answer is, "So what?" Many mass concrete and masonry dams built in the last forty years do show cracks, but none of them has failed or even threatened failure because of such cracks. If cracks should develop and should be of such magnitude as to permit undesirable leakage, modern grouting techniques will seal them at a minute fraction of the cost of the construction methods necessary to prevent formation of the cracks.

FRESH CONCRETE in Grand Coulee Dam is cleaned by high-pressure water jet. Elaborate methods of cleaning concrete between pours increase cost of monolithic construction without adding comparably to utility of structure, according to author Ross White.

Inspection Held Unnecessarily Rigid

Whatever may have been the situation a generation ago, today there is little difference in the training or ethics of the designing engineer and the engineer who is the responsible head or operator of a construction organization. Much government work is apparently handled on the assumption that poor work will result if every step in construction operations is not rigidly supervised. A ratio which is frequently reached and perhaps exceeded on government work is one government employee to every ten employees of the construction organization doing the work. In most private work, although the work is inspected, more reliance is placed on the character and reputation of the constructor than on monitoring every step of his work. An appreciable percentage of administrative costs on government work could be saved by following this practice without any loss in quality of construction.

Most plans for private construction have to pass the close scrutiny of an executive, be he owner, banker, or engineer, whose function is to see that money is not spent for anything that does not promise a return of some sort. It is suggested that plans for government work be subjected to similar scrutiny. Such an economic review might make planners and designers of these works more dollar conscious.

Simplification Can Save Money on Government Buildings

FRANCIS TOMPKINS, Assoc. M. ASCE

Executive Vice-President and Chief Engineer, Charles H. Tompkins Co., Washington, D.C.

IN GOVERNMENT building construction there are certain recognized limitations in the steps toward economy, such as the necessity for permanence, inspirational effect, and solidity of architectural appearance. Nevertheless, many economies have been effected in commercial, industrial and housing construction which could effectively be applied to governmental buildings.

The following are some of the steps proposed to obtain economies in government building construction: (1) Simplification and economy in structural design; (2) modernization and simplification of specifications; (3) selection of materials and architectural treatment for economy as well as for beauty and permanence; (4) avoidance of separate contracts on the same job; and (5) improvements in the conduct of the job and in contractor-engineer relations.

1. Simplification and Economy in Design

In spite of the fact that government architects and engineers usually are faced with problems of design which do not lend themselves readily to mass production, prefabrication and modular design, there are many elements to which these principles can be applied. As an example of what can be accomplished in this direction, the Public Buildings Administration recently produced some fine office buildings of a semimonumental character—the General Accounting Office Building and the Federal Office Building No. 4 at Suitland, Md., for instance—at a cost of approximately two-thirds that of comparable though smaller commercial office buildings.

By approaching the space requirements as the basic problem, and simplifying the structural design to the ultimate, they secured the maximum repetitive use of form panels and the minimum amount of beam form construction.

These principles were initiated in 1941 by the Citizens Housing Council of New York headed by Dr. Jacob Feld, M. ASCE, and have been applied under the New York Housing Authority. Because of their direct bearing on the subject at hand, parts of the Citizens' Housing Council report of 1941 are paraphrased below. These recommendations could be equally effective in government building construction. The report states that construction economies and earlier occupancy in monumental building construction can be obtained by:

1. Letting general contracts rather than individual contracts to separate trades.

2. Adopting skeleton or frame construction, instead of wall-bearing multi-story construction.

3. Designing the frame of reinforced concrete instead of structural steel.

4. Utilizing controlled concrete, since the saving in materials is greater than the extra cost of the controlled concrete.

5. Using mesh instead of rods for floor slab reinforcing.

6. Using high-strength steel bar reinforcing in beams and avoiding hooks and bends, even at the expense of added weight.

7. Avoiding the use of reinforcing in concrete for incidental items constructed prior to or after the major reinforced concrete is poured.

8. Reducing the number of joints in masonry by specifying oversize brick and tile units, and replacing back-up tile with cinder concrete block.

9. Using unglazed tile for walls, and colored monolithic cement sand finish for floors and stairs in public halls.

10. Utilizing high-quality factory-stock plumbing units.

11. Designing rigid partitions for the support of plumbing fixtures instead of providing legs for extra supports.

12. Adopting extra-heavy soil pipe instead of standard weight pipe.

13. Simplifying heating equipment, including boilers and controls, and eliminating little-used specialty items.

By the adoption of these recommendations, by standardization, by simplification, and by designing for mass production and repetitive methods within each project, the New York City Housing Authority has produced housing equal to or better than other housing in the country in quality of construction. At the same time during the period 1946-1949, when costs on all other construction rose appreciably, there was a negligible increase in the cost per cubic foot of the Authority's buildings.

In fireproofing structural steel beams, where the dimensions are determined only by providing the required coverage of concrete, it pays to put an extra few inches of concrete on many beams, if by so doing the form can be re-used elsewhere without remaking. It sometimes pays to Gunite very large beams rather than use formed and poured concrete.

The designer seeking maximum economy in a concrete structure will give the contractor the maximum opportunity for prefabrication. He will break the structure down into as many duplicate elements as possible; that is, he will employ modular construction. By providing for the ultimate in duplication of structural elements, the way is opened for the ingenious contractor to develop repetitive processes which will utilize the maximum amount of machinery in the shop and the minimum in the field.

Certain Government agencies have recently permitted their designers to visit the job at regular intervals, and in some cases have assigned them to the job for inspection. This contact with the job enables the designing engineers to see some of the problems that come about in the execution of the work. In one instance, at least, I know of a designer who eliminated hook bars in his designs after seeing the difficulty experienced in placing steel where column spirals were designed to extend from floor to floor, thus making it impossible to get the hook bars into the column forms. If designers were in closer contact with the field, they could better visualize the problems that arise in executing the work.

2 Modernizing and Simplifying Specifications

Old Prof. Mansfield Merriman, M. ASCE, of Lehigh, is said to have stated that "anyone can build a bridge but it takes an engineer to build one economically." Many engineers today seem to feel that the test of their competence is how complex they can make the specifications. Many Government specification writers seem to feel that the thickness of the book is the measure of the quality of the work or, at least, the measure of their ability as specification writers. But, by the same token, I can assure you that we have had subcontractors who literally picked up the book, and after gaging the weight of the specifications, raised their prices accordingly. In the not too distant past, many structures were satisfactorily heated under a contract written with a simple specification along the following lines: "Provide a hot-water heating system guaranteed to heat the building to 70 deg in zero weather." As a mechanical engineer I would not recommend so simple a specification, but it is quite efficient in getting the end result at a minimum of cost. In contrast, on one of our jobs the heating section of the specifications took up 180 pages of detailed descriptions of various materials and devices.

Another costly step is to restrict competition in specifications. There may be cases where only one manufacturer can furnish an article to accomplish the particular result desired; but if this is so it reflects on the imagination of the specifying engineer or on the ingenuity of American producers. It is only human, when a manufacturer has been specified outright, or when his design is written into the specification, if only by implication, for him to take all the price advantage that the traffic will bear.

Specification writers should also realize that an excessive number of alternates in the canvassing of bids is conducive to higher instead of lower costs. More often than not the contractor is faced with making estimates on a multiplicity of alternates—say 8, 10 or even in many cases 40 or 50 alternate bids—in addition to the base bid. Most of these alternates involve additions and subtractions of a number of trades affecting each item, which can only contribute to errors in estimates, or at best slow down the process of estimating at a very critical time in the making up of bids.

The majority of contractors are operating on a retrospective insurance rating plan, and receive a substantial reduction in insurance rates based on their safety records. Government safety engineers should recognize this fact and not harass a contractor who knows how to run his job and has had a satisfactory safety record. In certain Government agencies there has been a considerable overemphasis on safety requirements. This has been carried to the point where most prudent contractors are including a sizable sum in the estimates on large jobs to take care of the excessive and unnecessary steps demanded under the safety provisions of the general specifications and under the various safety manuals which are made a part of the contract.

Most successful contractors have found that it pays to run a safe job.

Good housekeeping more than pays for itself, but the safety provisions required by most engineers go far beyond good housekeeping or necessary steps to prevent accidents.

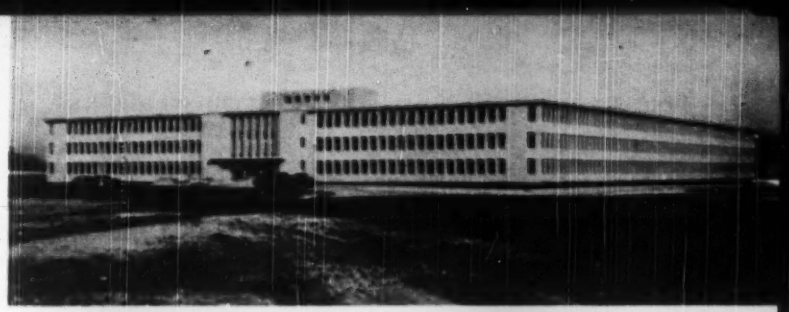
3. Selection of Materials and Architectural Treatment

It would seem that Government construction agencies, having at their beck and call the finest laboratories in the world for testing materials, could keep well abreast of all new materials, processes and methods in the interest of economy. Yet there is a considerable reticence on the part of some engineers in Government construction agencies to adopt methods that have not been tried and proved over a number of years.

Some of the materials and methods that have recently been successfully applied to other types of construction, but used only to a limited extent in Government buildings, are: Lightweight precast slabs and cast-in-place lightweight concrete; vacuum concrete for higher and earlier strength; cavity wall construction; precast architectural concrete instead of natural stone for ashlar walls and trim.

4. Separate Contracts for Electrical and Mechanical Work

There is no more important element in economical building than efficient coordination of all the work. This can be achieved only by placing full responsibility, and authority, on a single head. Where separate contracts are let on a single job this responsibility is not and cannot be achieved.



FEDERAL OFFICE BUILDING No. 4, in Suitland, Md., containing 2,850,000 cu ft, was completed in 1946 at contract price of $1,322,000 by Charles H. Tompkins Co., Washington, D.C., contractor, for Public Buildings Administration, FWA, with Gilbert Stanley Underwood, Supervising Architect.

Independent contractors operating on the same job, for their own convenience, will obviously interfere with one another. Yet the work of each is dependent upon the work of the others. The General Contractor is the only one who can coordinate these various phases and can avoid the interference and extra expense accruing to each, and to the owner. Some owners may be under the impression that by letting separate contracts they are removing from the contractor's bid a commission or mark-up on that much of the work, but this is not a fact. Any prudent contractor would include in his bid at least the same amount for overhead and profit whether the separate contract is direct with the owner or under his own jurisdiction.

5. Contractor-Engineer Relationships

A contractor who has had an expensive experience with unreasonable or inexperienced field engineers will tend to increase his bid prices. On the other hand, my firm tends to bid closer for agencies which specify exactly and concisely what they expect to get, and have inspectors on the job who are experienced enough to understand what the specifications intend, and expect us to hold to that line.

One of the officials of the New York Housing Authority made the following statement: "We are so peculiar that we believe contractors should be treated as part of the team—not as opponents." This attitude bears fruit, as the costs of the Authority's work show.

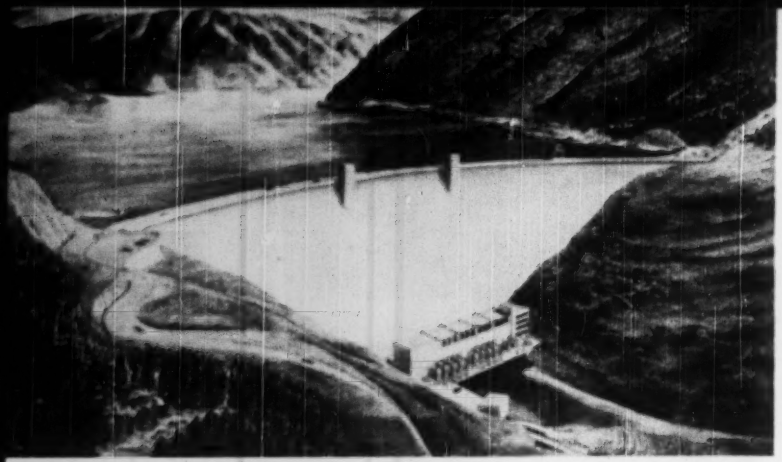
It appears that we are facing a continuing upward trend in wage scales with little or no corresponding improvement in the productivity of field operations. Unfortunately, there is no efficiency expert in the world as capable of improving production as the man standing on the sidewalk waiting to take the place of the man at the top of the ladder. It appears that this situation may not change in the foreseeable future.

Comprehensive Studies Cut Costs on Monumental Reclamation Works

GRANT BLOODGOOD, M. ASCE
Chief Construction Engineer, U.S. Bureau of Reclamation, Denver, Colo.

AS a Government agency, the Bureau of Reclamation has always maintained a sincere interest in lowering construction costs. It is concerned principally with the planning, design, and construction of multiple-purpose projects for the development of arid and semi-arid regions in the 17 western states. These projects embrace a wide diversity of structures such as dams, power plants, pumping plants, canals, and electrical transmission lines. The complexity of the problems inherent in the design and construction of many of these structures, and the magnitude of the plan in arriving at the most expeditious function of these reclamation features in the over-all scheme of each project, have challenged—and continue to challenge—the technical resourcefulness of our engineers. Coupled with these technical problems is the problem of increased costs of construction. The necessity of reviewing methods of reducing costs with greater perception is paramount if the projects are to be economically justifiable under Reclamation law.

The Bureau's current 387-million-dollar construction program—the largest in its history—emphasizes the great responsibility entrusted to it to construct projects by the most economical means possible. We are cognizant of the fact that, as one of the leading construction agencies of the country, it is incumbent upon us to continually review and scrutinize all phases of our construction program to achieve maximum efficiency and economy. Reclamation projects that have been built in western states during the past 47 years have had to be justified to such an extent that all, or most, of the construction costs could be repaid directly by those who benefit directly from the projects. This obligation to deliver low-cost irrigation water has been incumbent upon Reclamation engineers since federal reclamation was created by the Act of 1902 to ". . . make examinations and surveys for, and to



RESEARCH by Bureau of Reclamation will save estimated $4,750,000 in construction of Hungry Horse Dam by replacing 30 percent of cement with fly-ash pozzolan. Bureau is constructing this dam on South Fork of Flathead River in Montana under contract with joint-venture group, General-Shea-Morrison Co.

locate and construct irrigation works for the storage, diversion, and development of waters. . . .

In the early period of Reclamation construction, the task of keeping construction costs down on small projects was relatively simple. During the period of great expansion of recent years we have been faced with problems involving the use of poor storage sites and the transportation of water over long distances, through mountain ranges, or by pumping to high plateaus. In the last decade particularly, during which construction costs have risen rapidly, every phase of our operations has been subjected to close observation to determine where costs can be cut in order to limit the total project cost to an amount which can be repayed by the water users.

The progressive stages of development of a project are: (1) project planning, (2) research, (3) design, (4) contract administration, and (5) construction. A brief summary of our continuing efforts to reduce construction costs in each of these stages follows:

1. Project planning is carried on under the basic authority of the Reclamation Act. This important activity covers the initial planning of action whereby, for a given project, water can be brought to the land, hydroelectric power generated, floods controlled, and other benefits secured through utilization of water resources. A comparatively recent development in this initial function of Bureau work has been in the planning for utilization of water resources of entire river basins, which sets the pattern for investigations of feasible projects contemplated for construction within the basin.

By this basin-wide planning, which has become essential in the furtherance of project construction, maximum benefits at minimum costs are assured, and the possibility of expensive revisions in design or construction and duplication of structures is minimized. Planning on a basin-wide scope decreases the allowable margin for error in estimates of water supply and at the same time enables an evaluation of the complete utilization of the water of a stream system. Thus, such eminently important considerations as the determination of foundation conditions of dam sites and topography of canal and distribution system sites, can be evaluated prior to construction, and large construction costs that might have resulted from lack of this planning are obviated.

2. Experience in Reclamation engineering has shown that research, the second phase of development, can contribute materially in reducing construction costs. Some, but not all, of the savings due to research can be evaluated directly in terms of dollars and cents. The economies accomplished by a new material, method, or design concept resulting from studies on a single project may be extrapolated into similar future work. One of our recent research achievements has culminated in the decision to use a fly-ash pozzolanic material to replace about 30 percent of the cement in the concrete for Hungry Horse Dam, now under construction in Montana. It is estimated that this replacement of cement will result in an over-all saving of about $4,750,000 on this dam.

Many problems in engineering which cannot be solved readily by the usual methods of mathematical analysis can be solved at a saving through the use of scale models in research laboratories. For example, hydraulic model studies of the design for the spillway of Davis Dam resulted in a direct saving of about $190,000, and the application of the information thus obtained to other similar structures will result in savings of hundreds of thousands of dollars in the next few years.

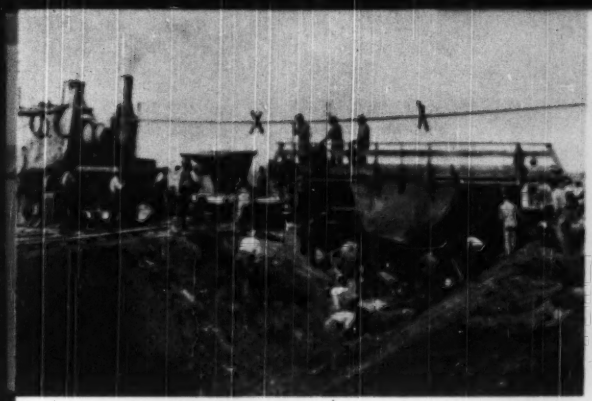
Results from research studies in the use of sulfate-resisting cement are expected to save over 20 million dollars in the next 20 years. Research in the inclusion of air-entraining admixtures in concrete to increase durability and workability and to decrease the quantity of cement is likewise expected to save hundreds of thousands of dollars on future concrete construction.

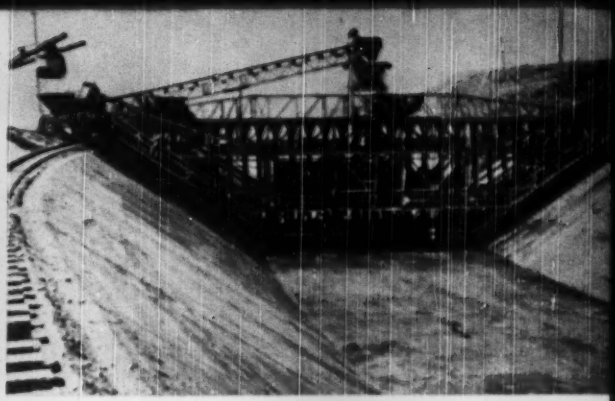
3. The Bureau has worked continuously on design improvement since its establishment. Standardization of designs has contributed materially to the economy of project construction. Material economies have resulted through standardization in canal siphon construction, bridge construction and canal lining work. Standardization of design of powerhouses, camp buildings, timber farm bridges, wood-pole transmission line structures, and small substations has resulted in further economies in construction.

Costs of concrete structures have been reduced through careful application of design criteria which has resulted in increases in the allowable compressive strength of concrete and in the working stresses in reinforcing steel. Working stresses for steel structures and switchyards have also been increased and the requirements as to slenderness ratios for these structures have been made less conservative. Lighter and cheaper structures have resulted.

A saving of 2½ million dollars on the construction of the Soap Lake Siphon on the Columbia Basin Project in Washington, was made by designing it as a concrete pipe lined with a continuous steel shell built in place instead of as a conventional plate steel pipe. A hundred thousand dollars was saved on the Prospect Mountain Tunnel of the Colorado-Big Thompson Project by eliminating reinforcing steel in the tunnel lining.

A saving of about $270,000 resulted from the elimination of surge tanks at two pumping plants; and an over-all saving of $120,000 was made by a simplification of concrete footing construction for transmission lines on the Davis Dam Project.





FIRST CONCRETE-LINING machine (above, left) constructed by Bureau of Reclamation was used on Umatilla Project in Oregon in 1914. Improved models, of which that in use on Main Canal of Columbia Basin Project (above, right) is recent example, have been responsible for speedier construction, more uniform lining, and lowered cost.

Numerous other cost saving possibilities are recognized and are applied as conditions permit and justify, including the utilization of wood-pole transmission-line construction in place of semi-rigid steel towers; substitution of prefabricated government housing for conventional-type permanent housing; use of standard commercial stock mill buildings for medium sized pumping plants; and the use of packaged prefabricated buildings for small substations.

4 and 5. To simplify bidding and to save expense for both the Bureau and the contractor, the plan of covering each major class of construction work by a standard volume of specifications was recently adopted on a trial basis. A standard book of specifications for canals and canal structures, now in use, defines all the requirements as to working method, precedure, tolerances, materials, and tests. The inclusion in the specifications of a paragraph on allowable tolerances has largely eliminated the variabilty of interpretation by field forces as to how exactly the work should be performed. Prior to this inclusion, it was necessary for contractors to bid on the assumption that relatively strict tolerances would be imposed throughout the work. Supplemental specifications will define conditions and requirements applicable to the particular job. By this method, a large amount of labor and cost will be saved in preparing and printing bidding specifications, and at the same time contractors who intend to bid on a job will be relieved of the necessity of studying the details of voluminous specifications.

Inequitable and arbitrary provisions contained in construction and supply contracts have been eliminated. Conferences with representatives of the Associated General Contractors resulted in the elimination of various clauses which were believed inequitable by that organization. One important change is in the reduction of the use of the term "or as directed by the contracting officer."

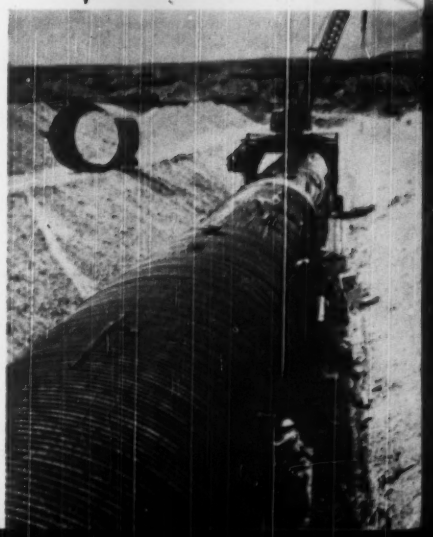
Considerable progress has been made in simplifying form work where the functioning of the structure is not adversely affected by such simplifications. Recent specifications have also provided that the contractors furnish various construction materials, such as cement, sand, gravel, and reinforcing steel. This change has been to some extent occasioned by the inability of the Government to procure materials in a reasonably short period of time, and in response to repeated requests from contractors' representatives. The position of the contractors is that when material procurement is their responsibility they can schedule other operations to fit the known delivery dates and so eliminate the costly and time-wasting changes in construction scheduling which have been caused in the past by Government failure to deliver materials on time. These actions have been reflected in unit price bids lower than would otherwise have been obtained.

Additional savings in the future are anticipated as the changes in policy become more widely recognized. A continuing study is being made to remove other inequitable conditions brought to the attention of the Bureau by the Associated General Contractors. Local materials are incorporated into structures when suitable and climatic conditions are considered at each individual job.

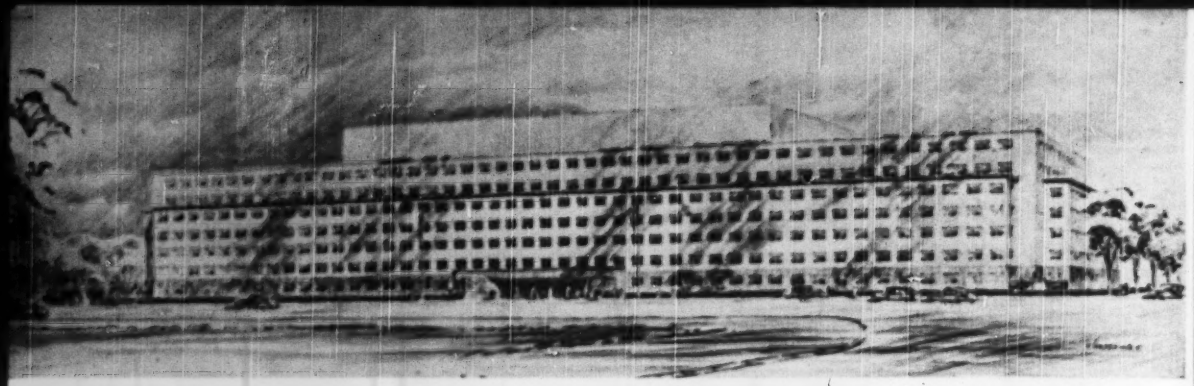
By keeping investigations abreast of construction, it is possible to determine more accurately foundation conditions and other necessary preconstruction data so that costly design changes are avoided and fewer contract adjustments are necessary. Every design change which is considered necessary after the contract is awarded is reviewed carefully to insure that the increased cost reflects a resulting improvement in the structure.

In addition to the points discussed, construction costs are affected by the less tangible factors of close cooperation with construction contractors and suppliers and the establishment of confidence in the fairness of the Bureau in its dealings with others.

Thus, in five important phases of the Bureau of Reclamation's operations—project planning, engineering research, design, contract administration, and construction—a concerted effort has been made and is continuing to lower construction costs.



SAVING of $2,500,000 in construction cost results from designing Soap Lake Siphon, Columbia Basin Project, Washington, as cast-in-place concrete pipe on continuous steel shell, instead of as conventional steel pipe. Siphon is being built for Bureau of Reclamation under contract by Winston-Utah at cost of about $8,000,000.



AMONG FINE OFFICE BUILDINGS produced by Public Buildings Administration is General Accounting Office Building, Washington, D.C. This 26,300,000-cu ft structure, now 40 percent complete, is being built by John McShain & Co. at contract price of $21,572,000.

New Standards Are Reducing Costs in Public Building Construction

W. E. REYNOLDS, M. ASCE
Commissioner of Public Buildings, Washington, D.C.

MODERN BUILDING construction is breaking away from some of the old standards. One factor that is receiving more and more attention is the reduction of dead load. The modern building is gradually shedding its cloak of fireproofing and its heavy curtain walls. Estimates indicate that 3,000 tons of plaster weight was saved in the General Accounting office Building in Washington, D.C., by using lightweight material. It is not visionary to suggest that the ratio of dead to live load may be reduced to as small as 1½ to 1 as compared to the old standard of 4 to 1. All these changes are taking place, despite the hindrance of certain building codes, and the fear that the conservative public will resist new standards.

The construction industry has, in recent years, been the happy hunting ground for columnists, radio commentators, and self-appointed critics. It has been accused of everything from dry rot to total incompetence. It has been described as the most backward of all our major industries. It is well for us in the industry to objectively appraise these charges.

Great progress has been made in the last fifty years in all phases of construction. Referring specifically to buildings, I can remember when door and window frames were generally made at the site of the work. When the first toilet was placed in the White House, a great hue and cry went up over the Nation that such an unsanitary facility should mar the Executive Mansion. The industry has made progress since those days. But is it enough?

By its very nature the building construction industry is highly complex and competitive. A large building, in its final form, will use products in one form or another from half the States of the Union. It does not, and cannot, lend itself to belt-line assembly. On the other hand, the individual parts that make up the whole do so lend themselves. And here is one of the possibilities for saving.

Definition of Economy

Before proceeding further, we should precisely define the phrase, "Getting more out of the construction dollar." Does it mean, in a building, more square feet? Or a better operating building? Or the provision of better working conditions? It means all these and more.

In its more comprehensive sense, the construction dollar includes land and approaches, the cost of the facility itself, and its operation, maintenance, and repair. These factors are influenced by varying climatic conditions, local environment, intended use of the building, and its probable useful life. In a restricted sense, the construction dollar means first cost only but to employ the term in that fashion is analogous to manufacturing an automobile without reference to repair, gas consumption, and comfort. It is poor engineering economics not to take into thoughtful consideration operating factors as well as first cost, but it is often done.

Our first emphasis should be on the working conditions of the people who will use the facility because results in any business operation are obtained through people. A few years ago air conditioning was considered a luxury. Not so today. It can be shown that the total cost of air conditioning, which includes operation, when related to people in an office building, represents about 1½ percent of the average salary of the employees. This percentage applied to an eight-hour day means seven minutes. Increased efficiency in the hot summer months would indicate that air conditioning is a sound investment. This is quite apart from the opportunities that air conditioning presents in flexibility of layout and design. The same basic arguments can be used for good lighting, proper interior color combinations, and acoustical treatment.

Building Design Simplified

An example of the approach of the Public Buildings Administration in stretching the construction dollar is the design of the seven-story General Accounting Office Building in Washington, D.C. The gross floor area of the building is approximately 2,000,000 sq ft. It is of the block type which provides minimum outside wall surface per square foot of floor. This also permits of a minimum air-conditioning load. Interior columns are spaced 25 ft on centers. Perimeter spans are 18 ft. The structure is flat-slab construction, depressed panels and flare-head columns. The floor-to-floor story height is 12 ft 8 in. and the ceiling height, 9 ft 10½ in.

All ducts, except under-floor ducts, are hung beneath the slab. The suspended ceiling hides all the duct and pipe work, including the flares on the columns. Movable partitions, all of the same height, are extensively used. The ceilings are acoustically treated. The lighting fixtures, of our own design and now standard with us, are of the hung type. The windows are heavy aluminum casements that swing inward for easy washing. Vertical transportation is handled by both elevators and escalators, the latter going up to the fifth floor.

On the outside the building has a granite and limestone facing. Only three sizes of limestone are used. Parapets are eliminated as they are always a source of trouble. The cost, including furniture and architectural and engineering services, is one dollar a cubic foot.

From this description it is seen that the Administration is concentrating on simplicity and maximum duplication. This policy extends to every trade on the job.

One of the great savings in the future will be through drawings and specifications that will more extensively use the belt-line operation of industry in the manufacture of products and subassemblies. Also we have scarcely scratched the surface in the potentially great inherent savings of modular construction.

I can recall when 12-ft-candles was considered good lighting. Efficiency tests have shown that this intensity is too low. We still use foot-candles as a guide but prefer to think in terms of ease-of-reading. There are many other factors, now little understood, that are perhaps more important than intensities of the light source. It has been demonstrated that for different combinations of ink, paper, and background, a change of light intensity to produce the same ease-of-reading may vary from 100 to 1,000 percent. Together with many others, we are now doing research on these factors, all with the objective of saving on the construction dollar.

In Washington the functions of government have imposed qualities of formality in architectural expression. I do not advocate a complete break in the use of classic motifs in those buildings housing the legislative, executive, and judiciary heads of the Government. However, in the great service structures of the various Government departments, agencies, and commissions, opportunity is at hand for bold steps into newer realms of design, engineering, materials, and techniques. The new General Accounting Office Building is a step in that direction. It is shorn of all affectation. Its simple mass and expansive unadorned wall surfaces have made it possible to get more building for the construction dollar.

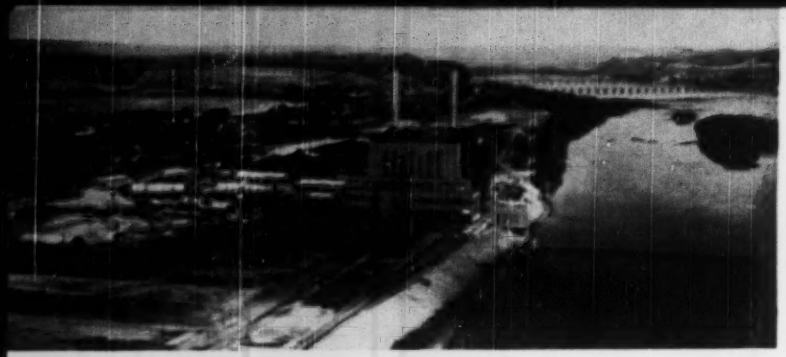
Even by applying present knowledge of lightweight construction in multi-story buildings, up to 10 percent of the cost can be saved under adverse foundation conditions. How fast and how far we can go in applying lightweight construction is a matter for individual judgment.

The things that are done singly or experimentally by judgment today, may be put on a quantitative basis tomorrow. An example of this is the survey we made on live loads in Government buildings—a survey that resulted in the method of live-load reduction now incorporated in the American Standard Building Code Requirements, and which appears in the latest edition of the National Building Code published by the National Board of Fire Underwriters.

What we need is more correlated research. This is not to imply that the research being carried on by industry and by our educational institutions is not thorough and extensive. But it needs welding and tying together. A good start in this direction is the Building Research Advisory Board of the National Research Council. It is patterned in principle after the Highway Research Board, which has done an outstanding job in the highway field for over twenty years.

Public agencies, I can say with confidence, are keenly alert to the problems of construction. All the larger ones in the Federal Government are doing extensive research work. This is made possible by the volume of work each is required to do. They are well away from the practice of some years ago of not using anything until it has definitely established its worth in private practice. With the fine relationship that exists between the research and operating staffs of private industry and Government and the aggressive spirit of architects and engineers everywhere, the construction industry can well be proud of the rapid progress that is being made.

STEEL-FRAME CONSTRUCTION was adopted as economical for Stuyvesant Town, foreground, and Peter Cooper Village, background, multi-dwelling projects of Metropolitan Life Insurance Co. in New York, N. Y., now completed and occupied. Photo shows status of work in February 1947.



SUNBURY STEAM-ELECTRIC STATION, on Susquehanna River, Pennsylvania, upon completion will require 500 mgd of circulating and service water. First two units, each having a rated capacity of 75,000 kw, are now in operation. When extended to house six units, plant will have rated capacity of 550,000 kw. Low dam extending across river, right foreground, prevents recirculation of discharge water.

Engineers Build 500-mgd Water System for Sunbury Steam Electric Station

CHARLES B. SEIB, M. ASCE

Hydraulic Engineer, Pennsylvania Power & Light Co., Allentown, Pa.

SUPPLYING water for the Sunbury Steam Electric Station, the world's largest single consumer of anthracite, involved, besides the usual intake, circulating, and discharge systems, the construction of a dam across the Susquehanna River to prevent recirculation of the effluent cooling water. The problem was complicated by the fact that the Susquehanna is classified as a navigable stream at the plant site. This fact, had it not been for the cooperation of federal and state officials, would have meant a tortuous road through the statute books. The details, both legal and technical, of the hydraulic system are reviewed in the following article. The paper from which this article is taken was initially presented before the Power Division at the Annual Meeting of ASCE by Mr. Seib, who is Hydraulic Engineer for Pennsylvania Power and Light Co., builder of the Sunbury Plant.

THE SUNBURY STEAM-ELECTRIC STATION, a base load station of the Pennsylvania Power & Light Co., must depend on the unregulated flow of the Susquehanna River for its entire water supply. Regulating the flow of the river was out of the question because protection of upstream communities from flooding would involve excessive costs. The problem was further complicated by the large water demands of the plant. The estimated requirements for an ultimate rated capacity of 550,000 kw are 712 cfs for circulating condenser cooling water, and 65 cfs for service water. This total demand, approximately 500 mgd, equals the estimated water requirements of the city of Philadelphia in the year 2000.

The plant is located along the west bank of the Susquehanna River approximately 2 miles downstream from the city of Sunbury and 3½ miles downstream from the junction of the Susquehanna's North and West Branches. The river at this location is classified by the federal government as a navigable stream. The drainage area at the plant site is about 18,200 sq miles, which is two-thirds of the entire drainage area of the Susquehanna River.

Since 1918 the Commonwealth of Pennsylvania has maintained at Sunbury a stream-flow gaging station, from the records of which it was determined that the minimum natural flow of the Susquehanna at the plant site from 1918 to 1945, was 1,220 cfs, which occurred on only two days. The river elevation at the plant site during this minimum flow was 413.

River water enters the intake bays through openings in the outer or river wall, Fig. 1. The openings are 9½ ft in width with the bottom at El. 409 and the top at El. 413. The river bed in front of the intake structure is paved with a concrete apron, whose upper surface is at El. 408, forming a lip 1 ft in height below the bottom of the openings. After entering the intakes, the water passes through fixed trash racks consisting of a series of steel bars installed to catch the larger debris which finds its way through the intake openings. Refuse from these racks is removed by a mechanical rake, dumped into a car, transported to a trough located at the downstream end of the intake structure, and sluiced back into the river below the dam.

After traversing the trash racks, the water passes through revolving screens to remove the finer material. The refuse collected on these screens is removed by water sprays and is also sluiced back into the river downstream from the dam. The normal operation of the screens and screen wash pumps is automatically controlled by a time clock which can be adjusted to meet river conditions. An emergency device has been provided to start the screens if the water differential across the screens exceeds a predetermined amount. Each intake opening is in a separate bay which contains a set of fixed trash racks and a revolving screen.

When the water passes through the screen bays it enters a common water chamber where a chlorine solution is injected periodically to prevent the accumulation of algae and other organic growth in the tunnels, piping and condensers. The injection is controlled automatically by a chlorinator located in the water treatment plant.

The water flows by gravity to the plant through two concrete intake tunnels. The dividing wall of the tunnels has offsets so designed as to provide ample suction bays at the circulating water pumps.

The floor of the intake structure is at El. 400 and at the tunnel entrance the floor slopes down gradually to El. 397. The elevation of the roof of the tunnels at their mouth is 410. As the tunnels pass successive units and the flow diminishes, the tunnel area decreases in ratio to flow. The tunnels are designed for a velocity of 4 ft per sec with a plant installation of 550,000 kw. Hydraulic losses for this installation, through the intake facilities and tunnels, will be about 1.5 ft with the trash racks and traveling screens 25 percent clogged.

Circulating water for each condenser is supplied by two horizontal double-suction centrifugal pumps

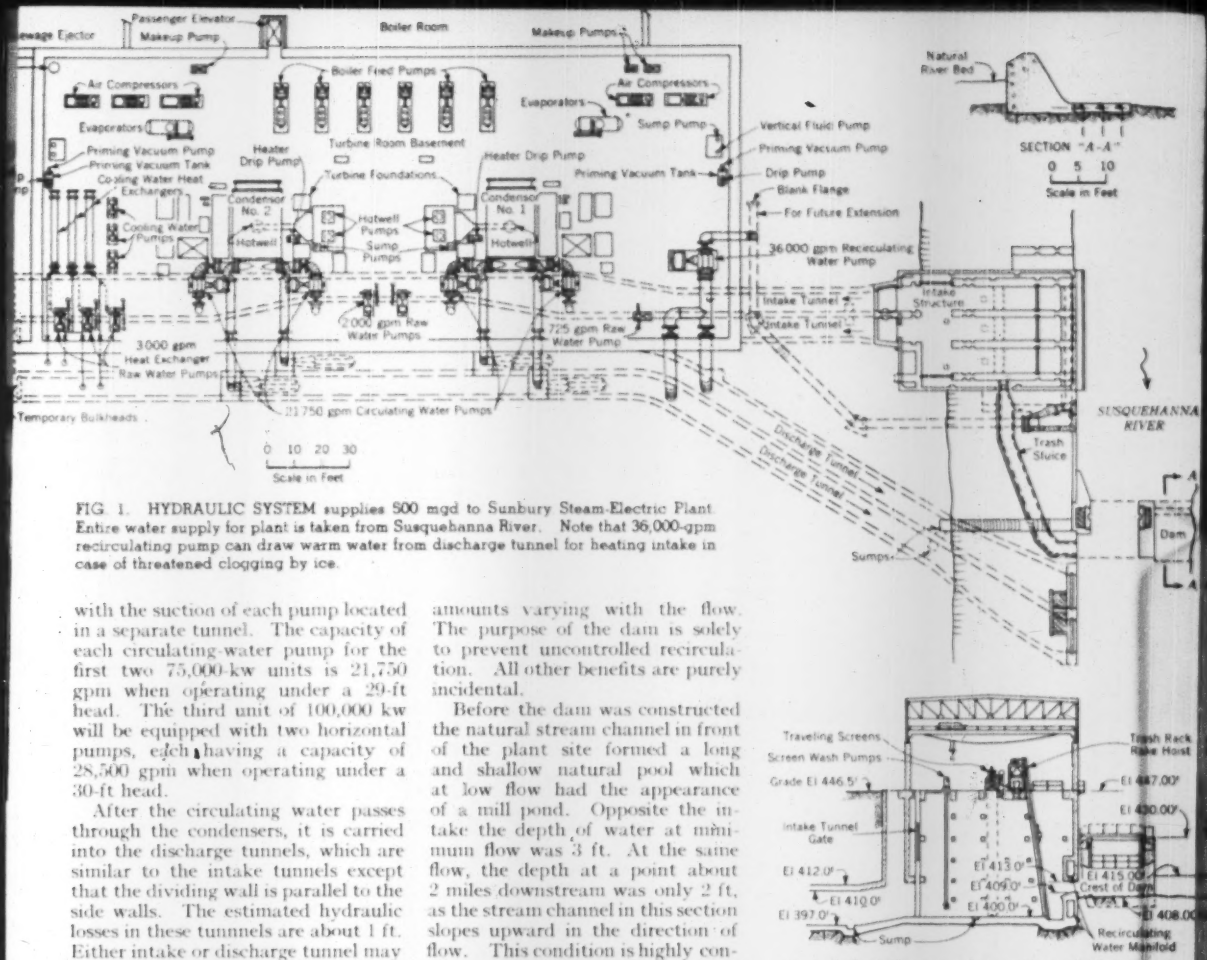


FIG. 1. HYDRAULIC SYSTEM supplies 500 mgd to Sunbury Steam-Electric Plant. Entire water supply for plant is taken from Susquehanna River. Note that 36,000-gpm recirculating pump can draw warm water from discharge tunnel for heating intake in case of threatened clogging by ice.

with the suction of each pump located in a separate tunnel. The capacity of each circulating-water pump for the first two 75,000-kw units is 21,750 gpm when operating under a 29-ft head. The third unit of 100,000 kw will be equipped with two horizontal pumps, each having a capacity of 28,500 gpm when operating under a 30-ft head.

After the circulating water passes through the condensers, it is carried into the discharge tunnels, which are similar to the intake tunnels except that the dividing wall is parallel to the side walls. The estimated hydraulic losses in these tunnels are about 1 ft. Either intake or discharge tunnel may be taken out of service with all units in operation.

The intake tunnels are located under the turbine-room basement floor. The discharge tunnels are outside of the building wall, below and supporting, the main generator step-up transformers and fire walls.

Concrete Dam Across River

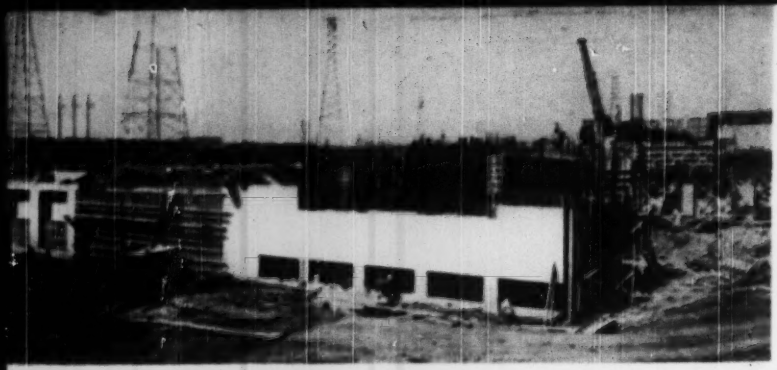
Water from the discharge tunnels enters the Susquehanna River about 75 ft downstream from the intake. To prevent uncontrolled recirculation of the discharge water, a low gravity-type concrete dam with the crest at El. 415 was constructed across the Susquehanna between the intake and the discharge. The dam is not needed for the diversion of river water or stream regulation. While it provides a little storage benefit, the capacity is far too small to produce any appreciable flow regulation, nor is the dam needed as a head-producing device, although it provides some slight head benefit by reducing the circulating pump head in amounts varying with the flow. The purpose of the dam is solely to prevent uncontrolled recirculation. All other benefits are purely incidental.

Before the dam was constructed the natural stream channel in front of the plant site formed a long and shallow natural pool which at low flow had the appearance of a mill pond. Opposite the intake the depth of water at minimum flow was 3 ft. At the same flow, the depth at a point about 2 miles downstream was only 2 ft, as the stream channel in this section slopes upward in the direction of flow. This condition is highly conducive to recirculation when condenser discharge water is returned to the pool. Two alternatives for the prevention of uncontrolled recirculation were (1) an artificial barrier such as a dam, or (2) a very long discharge conduit to carry the water far enough downstream to prevent its backflow to the intake. A long discharge conduit would increase the pumping head rather than decrease it as does the dam. While the incidental benefits and disadvantages of the two plans were difficult to evaluate, economics definitely favored the dam.

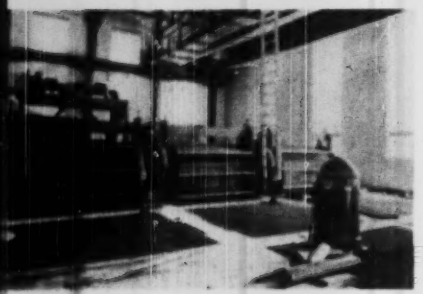
The dam is equipped with a gate 18 ft wide with the outboard gate pier forming the western abutment of the dam. The function of the gate is to prevent silt and rolling debris from collecting in front of the intake structure. The gate is 5 ft high, while the height of opening measured from the sill to the dam crest is 7 ft. This difference in height permits the gate to be raised 2 ft above its seat while maintaining a uniform crest level across the gate and dam. It is expected that the scouring action of the current due to its accelerated velocity through the opening beneath the gate will be of considerable aid in keeping the intake apron clean. If desired, the gate can be lowered to its seat to sluice off debris floating on the surface. The gate can be raised to clear the opening entirely if desired.

Permit Required for Dam Construction

In order to construct the dam it was first necessary to secure a permit from the Commonwealth of Pennsylvania. At first the Water and Power Resources Board of the Commonwealth was only willing to grant a Limited Power Permit, which would be very unsatisfactory because it contains a recapture clause, granting the Commonwealth the right to capture the dam through purchase within a certain designated period. After it was more fully explained to the Board that the dam was not a diversion dam but was constructed merely to prevent recirculation, a permit without a recapture clause was granted.



INTAKE OPENINGS 4 × 9½ ft will draw water from Susquehanna River for Sunbury Plant. Discharge at extreme left is now separated from intakes by dam structure.



REVOLVING SCREENS AT SUNBURY PLANT remove fine material from river water after it has passed through trash racks. Material washed from screens is sluiced back into river downstream from dam. Mechanical rake, upper part of which is visible in background, cleans trash racks. Motor in foreground operates one of the pumps used in washing screens.

The Federal Power Commission claimed no official interest in the Sunbury Project. If it had had such an interest under the law then the consent of Congress would not have been required.

Before a Bill was submitted to Congress to secure consent to construct the dam, several meetings were held with representatives of the Corps of Engineers, U.S. Army, to acquaint them with just what was proposed and to make sure that they were in full accord. Of particular concern was the effect, if any, which the construction of such a dam would have on the proposed flood protection project for the city of Sunbury. It was found from a concurrent study by Pennsylvania Power & Light Co. engineers and representatives of the Corps of Engineers that the effect would be slight, and the Corps of Engineers agreed to interpose no objection to the construction of the dam.

Following the usual procedure, the Bill was referred to the Committee on Rivers and Harbors for its consideration. The Committee reported favorably on the Bill, and it was passed by both the House and the Senate. While the Bill was in the hands of the President of the United States, for his signature, Congress adjourned. This meant that if the President did not sign it within ten days, a "pocket veto" would result. However the President signed the Bill within the required time.

The next step was to seek approval of the plans from the Chief of Engineers. Before he gave formal approval, a public hearing was held to give all interested parties an opportunity to express their views on the construction of the dam. The only objection, that concerning pleasure-craft navigation, was investigated and ironed out, and formal approval to proceed was received on October 28, 1947.

Flood Protection

Since 1786 the recorded maximum elevation of the river at the plant site was 442.6 with a discharge of 556,000 cfs, which occurred on March 19, 1936. During this flood practically the entire plant site was flooded. To protect against a recurrence of this flood, the operating area was filled to El. 446.5. Also dikes were constructed around the coal and ash storage areas to prevent erosion and washing of these materials into the river channel during flood periods. This protection is required by the Commonwealth of Pennsylvania's Pure Stream Act of 1937, as amended. The top of the dikes is 10 ft in width with a slope of 1 : 2 on the land side and 1 : 2½ on the river side.

The construction of the dikes and the building up of the operating area reduced the area of water way in the flood plane considerably and it was necessary to secure a permit for this work from the Water and Power Resources Board of the Commonwealth of Pennsylvania. Since the Susquehanna River at Sunbury is classed as a navigable stream by the Federal Government, it was also necessary that the work be recommended by the Chief of Engineers and authorized by the Secretary of War.

As was the case with the dam, the question arose as to whether the proposed flood protection at the plant site would have any material effect in increasing the flood stage at Sunbury, which would greatly increase the cost of the federal flood control project. It was found after careful study that this effect would be slight, and a permit was issued by the Water and Power Resources Board for the Commonwealth of Pennsylvania and by the Secretary of War for the U.S. Government.

Temperature is a very important factor when considering water for condensing and cooling purposes. After carefully weighing all available data, it was concluded that river temperature peaks at Sunbury were not likely to exceed 85 deg F, and condenser design proceeded on that basis.

Precautions Against Ice Interference

Special precautions have been taken to prevent ice from interfering with the operation of the plant. During the winter months there are three distinct forms of ice to be considered at the intake structure—sheet ice, frazil ice, and anchor ice.

Sheet ice is not expected to form in front of the intake structure because of the comparatively high surface velocity approaching the dam. If unusually severe cold does cause the upstream ice sheet to extend to the intake structure, its thickness can exceed 2 ft before any reduction in the area of the intake openings occurs, as the tops of the openings are 2 ft lower than the dam crest. The contour of the dam crest was designed to minimize the possibility of an ice jam.

To prevent adherence of frazil and anchor ice to the trash racks and revolving screens, a recirculating pump has been provided which takes warmed water from either or both of the discharge tunnels and discharges it through orifices located in manifolds in the top and bottom of the intake openings. By injecting this water in front of the trash racks and mixing it with the incoming river water a temperature can be maintained which will prevent any clogging by ice.

The quantity of water which can be recirculated with the pump now installed is 36,000 gpm, providing a recirculation of approximately 25 percent with the first three units in operation and approximately 11 percent with the entire installation of 550,000 kw in operation. The piping

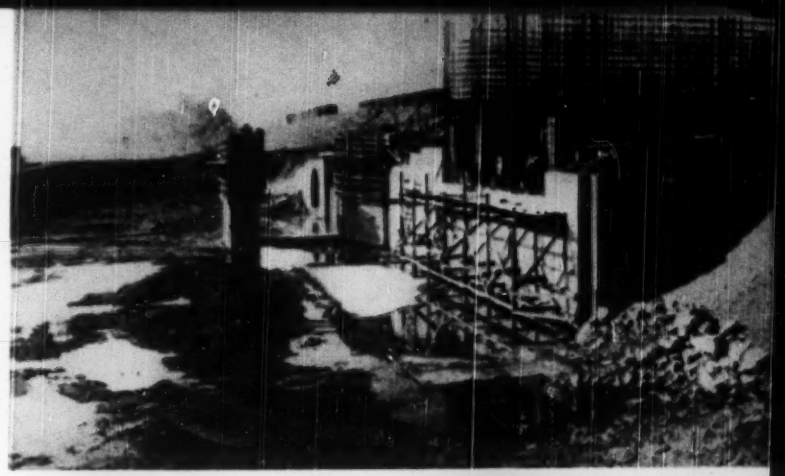
serving this pump is so arranged that it can take its suction from either discharge tunnel. With this amount of recirculation, if uniform distribution is obtained, and if the temperature rise of the circulating water is 20 deg F, the temperature of the intake water will be more than ample to eliminate any trash-rack trouble from frazil or anchor ice. Space has been reserved for the installation of a second pump, and all other facilities have been designed to take care of a discharge of 72,000 gpm.

Since July 1945, samples of the river water flowing past the plant site have been taken periodically and subjected to complete chemical analyses. As a result of these analyses the treatment required to produce a satisfactory quality of water from the raw river water was determined.

For condensers, heat exchangers, ash sluicing and revolving screen washing, it was found that river water is satisfactory in its raw state, plus chlorination, as previously mentioned, to control algae.

All other equipment cooling water is in a closed system with make-up taken from the condensate system employing a heat exchanger through which raw river water is passed as a cooling medium. Water for fire protection, for sealing all filtered and raw water pumps and for emergency back-up for the cooling system is coagulated and filtered. Boiler make-up water is coagulated, filtered, softened, evaporated and deaerated. The sanitary and potable water is coagulated, filtered, softened and chlorinated.

The water treatment plant is served normally by one 725-gpm raw-water pump. The piping for this pump is so arranged that it can take its suction from either one of the intake tunnels or from the suction line of the recirculating pump, thus providing suction from either discharge tunnel. For the first two turbine generators, two 2,000-gal per min ash-water pumps have been provided but only one is required during ash-sluicing periods. The other pump acts as a standby, both for ash-sluicing and for the 725-gpm raw-water pump. All three of these pumps are located in the turbine-room basement. The discharge piping is so arranged as to form a loop within the main station building. From this loop there are two connections, providing two raw-water supply lines to the water treatment plant. These connections are so located and the loop so valved, that half of the loop can be taken out of service and raw water can still be supplied through the remaining half of the loop to the water treatment plant.



GATE UNDER CONSTRUCTION between intake structure (foreground) and discharge (background) will keep intake clear of debris and silt. When gate is fully seated, water flowing over top will sluice floating debris from behind dam, which is to be constructed at left of gate pier, running at right angles to intake structure. When gate is raised, flow of water will scour silt from in front of intake.

Equipment for coagulating, filtering, softening and chlorinating is housed in a separate building located north of the main station. The equipment installed initially will be adequate to meet the requirements of the first two units now in operation, and the third unit now being installed.

Coagulating equipment consists of two reactivators each having a nominal rating of 200 gpm. The tanks are vertical, welded, steel cylinders lined with Gunite. Lime and alum are the chemicals employed.

Effluent from the reactivators flows directly to two of the three 200-gpm gravity filters. The filter tanks also are vertical, Gunite-lined, welded, steel cylinders. Anthracite coal graded in size is the filter medium chosen as best suited to minimize the silica content of the water, some of which is used as boiler feed. Independent clear wells of similar construction are mounted directly beneath the filter tanks and support each filter.

Three clear-well pumps deliver the filtered water to a 500,000-gal steel standpipe. Standpipe storage not only permits operation of the filters and reactivators at a uniform rate independent of plant demand, but also provides an adequate supply for emergencies.

Four filtered-water pumps deliver water from the standpipe to the filtered-water system and also to the softeners for further treatment. The pump capacities are one at 270 gpm, two at 675 gpm, and one at 2,000 gpm at a 200-ft head, and are used to develop the pressure for the filtered water, softened water and potable water systems. The smaller pump runs continuously and the others are started by pressure switches as required.

There are two vertical zeolite softeners of the downflow pressure type, rated at 470 gpm each, and having welded steel tanks lined with Heresite. The exchange material is a carbonaceous base mineral. Water for sanitary and potable use passes from the softeners to the chlorine diffusion tank for disinfection. The rest of the softener effluent passes through the evaporators before entering the condensate system as make-up water.

Ash Disposal Equipment Provided

After leaving the air heater, the boiler gases pass through mechanical dust separators, which remove the coarse particles of fly ash which are expected to contain a considerable amount of carbon. This material is to be returned to the furnaces for reburning.

The gases, after leaving the mechanical dust separators, pass through the electrostatic dust separators. Dust collected here has little value and the dust from the hoppers is piped to the ash-transfer sumps. Ash from the boiler ash hoppers is sluiced to these sumps.

There is an ash-transfer sump for each pair of boilers and each sump is equipped with two ash pumps. These pumps force ash-laden water containing about 10 percent ash through an 8-in. steel line to the ash-disposal area. Each pump is capable of transporting approximately 50 tons of ash per hour. Two pumps are installed in each ash sump, but one is a

(*Continued on page 92*)

Civil Engineers Can Further Aims of United Nations

An address to the New York Meeting of the Construction Division

ERNEST E. HOWARD, President, ASCE
Howard, Needles, Tammen & Bergendoff, Kansas City, Mo.

IT IS SIGNIFICANT, and should not be surprising, that the Construction Division should be the largest Technical Division of the Society and that more members of the Society should be identified with it than with any other Technical Division. For all engineering effort finds its use, its consummation, its final flowering, in the completed and usable structure. Here is demonstrated the William James philosophy of pragmatism. What counts in thinking is the final result of the thinking. In engineering, if there ultimately results no construction, or no effect on construction, even after a long time, then the thinking has been in some respect at fault. The Construction Division represents the accomplishment, the culmination of engineering thought. Indeed the origins of engineering are found not in theories but in actual building. Construction operations came first; the theories of construction came later.

Attention Directed to World Affairs

It is typical of this dynamic group, whose field of endeavor covers the earth, that it should direct its attention to world affairs and to what the engineer can do to advance the purposes of the United Nations. In fact, there can be few men in the world who do not subscribe to the four general purposes of the United Nations: (1) to maintain international peace and security; (2) to develop friendly relations among nations; (3) to achieve international cooperation in solving international problems of an economic, social, cultural and humanitarian character; and (4) to function in harmonizing the actions of nations in the attainment of these ends.

The third purpose seems closely to approach the service which engineers regularly render to society. The accomplishments of engineering are for the benefit of people. It is for people that water supplies and sanitation and roads and bridges and power plants and buildings and all the structures of engineering are provided. The scientist who termed "humanity a scrofulous itch on the face of a minor planet" was no engineer. As engineers and their works are largely responsible for the present physical pattern of our lives, so will this third purpose, when fully made effective in all that may be included under it, have a broad impact on almost every phase of the world's life and activity.

A program of far reaching significance applicable to this general purpose was outlined in the well-known Point IV of President Truman's Inaugural Address of January 20, 1949, to which the President so specifically directed the attention of engineers in his remarks at the meeting of the ASCE in Washington on November 2nd last. This is the program for assisting peoples in economically underdeveloped countries to raise their standards of living. It should not be regarded as merely an altruistic expression of good will, for in addition to helping others it is designed to serve primary interests of this country, including an increase in our trade and economic stability. This is said to be the first time that any government has made the economic development of other independent countries a major feature of its foreign policy.

Broad Interpretation of Economic Aid

After pointing out that more than half the world lives in conditions approaching misery, the victims of disease, with inadequate food, with a primitive economic life, with poverty as an ever-present threat, the President outlined a broad program of assistance to economically under-developed countries, with stress on the following ideas: That the program should be designed to assist the peoples of other countries to raise their own standards of living; that the material resources which the United States can afford to use for others are limited; that the technical knowledge which can be shared appears to be inexhaustible; that scientific advances and industrial progress must be integral parts of the program for peace and freedom; that this program is not a one-nation job but rather must be a cooperative enterprise in which all nations work together through the United Nations and its agencies. In other words, we are neither rich enough nor wise enough to do it all, or even to plan it all.

The concept of the possible economic efforts under the Point IV program has been broadly interpreted to be much more far reaching than mere improvements in the techniques of agriculture, transportation, communications and industry. The last report of the Brookings Institution comments on the many difficult problems which arise in planning the details of such a broad program. For instance, consideration must be given to the relations of peoples to their governments, which over the world vary as widely as their physical condition and cultural development.

Yet it must be agreed that certain of these practical and technical improvements are primary and that the first should doubtless be to provide proper and adequate food. It is difficult to interest hungry and undernourished people in education and other cultural developments. Relief of hunger involves not only, better methods of food production but better facilities for its preservation and distribution. At once improved water supplies, sanitation, and other conditions affecting health enter the picture. We can urge and foster these and other technological developments with the certain faith of demonstrated results. It is to such accomplishments, the fruit of individual enterprise under a free competitive society, that this country owes the highest standard of living the world has so far known. Other lands have natural resources in some respects exceeding our own. But untouched, undeveloped resources are merely dead potentialities. They become resources only as man develops them. And man can accomplish the most where he is most free.

Technical Assistance and Opportunity Needed

Some of the countries that are under-developed economically have produced and are represented by men of notable intellectual stature, as scientists, educators, statesmen, and professional engineers. Engineers from

such countries have said to me, "We have not equaled your accomplishments because we have not had the opportunity." Such men are surely eager to take over and carry on technological developments in their own countries when given some help in developing the opportunity. With these, our fellow professionals, we stand ready to serve.

Here again it is assistance, technological assistance, that is emphasized, and not any taking over of technological operations. It is contemplated that to the greatest extent possible the receiving countries will provide most of the capital, by taxes or otherwise. It is proposed that supplemental capital should be secured from private investors by making the investment profitable enough and safe enough to attract such capital away from home investments.

The technological services which the engineering profession can and will provide in such programs will be obvious to all and generally will be willingly accepted. But if that is the full measure of the service to be rendered by the engineering profession, this country, the world, and the United Nations will have failed to take advantage of the full capacities of the engineering profession. These potential capacities are not on the plane of execution of details of engineering projects in agriculture, in irrigation, in transportation, in water supply and sanitation, but in the realm of policy making, broad planning, negotiation, finance, and administration. Industry has long recognized that engineering training and experience provide a background for executive administration and planning. It would be easy to list scores of engineers who occupy administrative posts as presidents and other directing heads of great corporations.

To promote the purposes of the United Nations, those capacities of the profession should be called into service which *The New York Times* discovered a few years past in connection with the reports of the Engineers Joint Council Committee on the Industrial Disarmament of Aggressor States. That newspaper commented editorially on the availability for national purposes of the organized engineering profession and concluded, "Our own Government might do well to utilize even more fully such a natural resource."

The engineering profession has not been inactive in the affairs of the United Nations. In 1946 engineers served on the Joint Advisory Committee on Development of the UN Headquarters, and since that time the profession has played a leading role in international cooperation in the planning and construction aspects of the permanent UN Headquarters. In 1947 Engineers Joint Council was elected to the National Commission advisory to our government on UNESCO matters. The EJC representative is Robert M. Gates of the ASME. EJC has appointed a committee of eight counselors to Mr. Gates, of whom two are members of ASCE.

Government has been slow to recognize or to take advantage of the resource which it has available in the engineering profession. We are therefore pleased and gratified that the President of the United States has so just an understanding of the place of the professional engineer in organized society. At the Washington Fall Meeting he not only paid tribute to the services engineers have rendered and can render, but also expressed the view that it would be advantageous to have some engineers in the State Department. The profession will not fail to respond to the call to service.

Steam Power Plant Hydraulics and Freeway Design Treated by Annual Meeting Speakers

Condensing-Water Supply—Allen W. Reid

Many questions that arise in the design of steam-electric plants are within the domain of hydraulic rather than structural or mechanical engineers. Deploring the lack of discussion of these problems in most published descriptions of steam-plant projects, Allen W. Reid, in his paper, "Hydraulic Problems of Condensing-Water Supply," delivered before the Power Division at the ASCE Annual Meeting, relates some of the problems he has encountered in this field.

Among the examples cited was the condensing-water intake structure for a steam plant on Seneca Lake, N.Y., where a changing shoreline clogged the intake and necessitated the installation of a steel intake pipe extending 550 ft into the lake. Other problems mentioned are concerned with currents caused by discharge flows which in turn create silt deposits and other navigational hazards, and shifting bars in a river bed which clog intakes and result in shutdowns. Mr. Reid, Hydraulic Engineer of Gilbert Associates, Inc., Reading, Pa., stated that he cited his own experience in the hope of promoting further discussion of such problems.

Freeways—Fred Grumm

The steady growth in the number of motor vehicles and in their increased miles of travel, interrupted only slightly during the war years, and the more recent great increase in the hauling of goods and in the mass transportation of passengers, far exceed the money available for the needed highway improvements, Fred Grumm, M. ASCE, declared in his paper, "Progress Toward the Ultimate in Highway Transportation," delivered before the Highway Division session. The urgent need for greater highway capacity can only be met by large increases in funds to build highway facilities of greater capacity, Mr. Grumm, Deputy State Highway Engineer of California, continued. But lest we again find ourselves short of adequate highway facilities, we must revise our ideas of highway design.

What is needed is not just an expanded conventional type of road, but rather a new kind of highway which will provide maximum uninterrupted, expandable capacity with the additional attributes of greater safety and increased comfort for the motorist.

Such a facility is the freeway, which has been defined by the American Association of State Highway Officials as "an expressway with full control of access." This full control of access is the first and probably the principal beneficial quality of the freeway. Interference from the developed roadside is the greatest contributor to congestion, high accident frequency and reduced capacity. Controlling the access from abutting property reduces the interference and its attendant evils. And, although traffic increases, these good qualities are preserved instead of being lost or destroyed as on the conventional type of road.

We are approaching the ultimate in highway facilities in the development of the freeway.

Navigation Lock Leading Into New Orleans Harbor Rests on 5,900 Piles

HYDRAULIC PIPELINE DREDGE was passed through levee from Mississippi River to make excavation for Algiers Lock, after which levee was replaced. Following completion of excavation, dredge was returned to Mississippi by same route and levee again rebuilt. Dredging contractor was Inland Construction Co. About 137,430 cu yd was removed by truck and 232,410 cu yd was dredged out to lower site maximum of about 25 ft.

GEORGE H. HUDSON, M. ASCE

Chief, Engineering Division, New Orleans District, Corps of Engineers

BARGE TRAFFIC VOLUME on the Intracoastal Waterway through New Orleans has increased to such an extent in recent years that a second lock is needed to pass barges through the levee between the Mississippi River and the western continuation of the waterway. The new lock is now being built near Algiers, below the New Orleans wharf area. The Algiers Lock, 75 × 760 ft, is supported on piles and will be equipped with sector-type gates. In this article, based on his paper presented before the Waterways Division at the ASCE Annual Meeting, Mr. Hudson describes the pile-supported lock structure which, together with the appurtenant navigation channel, bridges, drainage structures, and utility modifications, will be completed in 1952 at a cost of about $13,000,000.

ENGINEERS CHARGED with the design and construction of the Algiers Lock on the Intracoastal Waterway at New Orleans, faced the problem of supporting a 120,000-ton structure on the highly unstable clays typical of the Mississippi delta. In fact, once the surface layer was removed by truck, the underlying material was too soft to support dry-land excavating equipment. A hydraulic pipeline dredge, brought through the levee from the Mississippi River, continued the excavation down to about 25 ft below mean low Gulf level. After unwatering, 5,898 untreated pine piles, each capable of carrying 20 tons, were driven 50 to 55 ft to a stable sand strata, as will be explained in the article.

The Intracoastal Waterway, Gulf Section, is an artificial channel for

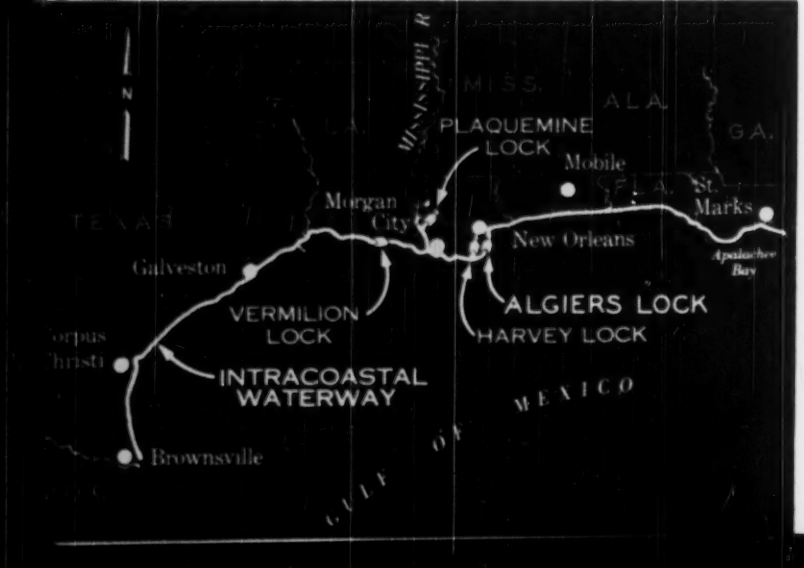


FIG. 1. INTRACOASTAL WATERWAY extends 1,150 miles along coast of Gulf of Mexico from Apalachee Bay, Florida, to Brownsville, Tex., at Mexican border. At New Orleans, locks are required through levees at each side of Mississippi River to raise vessels to varying river level. New Algiers Lock, on west side of Mississippi, when completed in 1952, will supplement present Harvey Lock, capacity of which is greatly overtaxed by increased traffic in Louisiana section of waterway. Connection through levee on east side of Mississippi is through Inner Harbor Navigation Canal Lock (Fig. 2).

shallow-draft vessels extending along the coast of the Gulf of Mexico, generally following open sounds and bays and making connections with important Gulf cities as shown in Fig. 1.

As the waterway approaches New Orleans from the east it passes through the Mississippi River levee by way of the Inner Harbor Navigation Canal Lock (Fig. 2). This lock is 640 ft long, 75 ft wide, and 31.5 ft deep at low water. From the west the connection is through Harvey Lock, which is 425 ft long, 75 ft wide and 12 ft deep at low water. A connection with the Mississippi River from the west is also provided by the Plaquemine-Morgan City route and the lock at Plaquemine, La. (Fig. 1), about 100 miles above New Orleans. This lock is only 260 ft long, 55 ft wide, and 10 ft deep at low water. To rectify the inadequate size of the Plaquemine-Morgan City route, Congress has authorized its modification to provide a 12×125-ft channel, and its extension to Port Allen with a new lock at the Mississippi River.

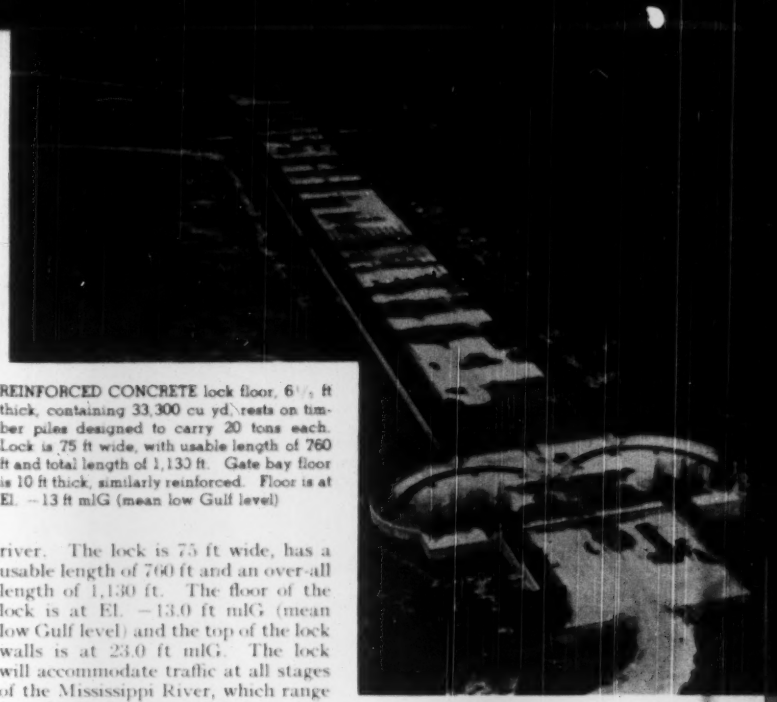
Barge Traffic Has Greatly Increased

When the construction of the Intracoastal Waterway was authorized in 1925, it was expected that 500,000 tons of commerce annually would move through the Louisiana section. Since Harvey Lock was opened to commerce in 1934 the annual tonnage has increased rapidly, reaching a maximum of 11,400,000 tons in 1944. The great volume of traffic has greatly overtaxed the capacity of Harvey Lock. Also, as there is no closed navigation season, general lock repairs cannot be made without stopping traffic. For these reasons it was decided to construct another connection between the Intracoastal Waterway and the Mississippi River at New Orleans. To keep through Intracoastal Waterway traffic out of the most congested area of the New Orleans harbor, and to relieve congestion at Harvey Lock, the new lock was located in the vicinity of Algiers, below the New Orleans harbor area.

The plan of improvement authorized by Congress in 1945 provides for a 9-mile channel 12 ft deep by 125 ft wide extending from the Mississippi River (Mile 88) to the Intracoastal Waterway at Mile 6 from Harvey Lock (Fig. 2), a lock with appurtenances at the Mississippi River, and readjustments of highway, railway, drainage, power-line, and telephone facilities.

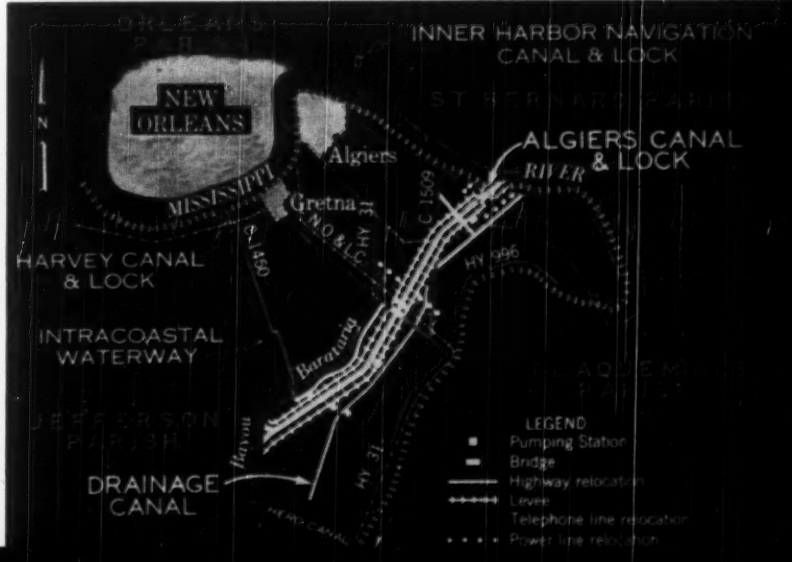
The Algiers Lock, now under construction, is located 2,000 ft back from the river to provide adequate approach for tows entering from the river. The lock is 75 ft wide, has a usable length of 760 ft and an over-all length of 1,130 ft. The floor of the lock is at El. −13.0 ft mlG (mean low Gulf level) and the top of the lock walls is at 23.0 ft mlG. The lock will accommodate traffic at all stages of the Mississippi River, which range from 18 ft above to 1 ft below mean low Gulf level.

A soils investigation of the lock and canal sites was made as part of the surveys and studies necessary to plan the proposed structures. (See Fig. 3.) Since the gas and hydrostatic uplift pressure (1.8 tons per sq ft) in the upper sand layer (at El. −54) exceeded the weight (1.5 tons per sq ft) of the earth between the top of the sand and the bottom of the proposed excavation, this pressure had to be lowered to insure against upheaval. Four large gas relief wells were therefore installed outside the excavation. Although a large amount of gas escaped from these wells, the quantity was insufficient to cause any noticeable reduction of gas pressure within the excavation area. The pressure was finally lowered to a safe value by installing 2-in.-dia relief wells, 100 ft apart, along the −10 contour of the excavation slope after the water in the excavation had been lowered to about El. −8.



REINFORCED CONCRETE lock floor, 6½ ft thick, containing 33,300 cu yd, rests on timber piles designed to carry 20 tons each. Lock is 75 ft wide, with usable length of 760 ft and total length of 1,130 ft. Gate bay floor is 10 ft thick, similarly reinforced. Floor is at El. −13 ft mlG (mean low Gulf level)

FIG. 2. ALGIERS CANAL, now under construction, branches off from Intracoastal Waterway south of New Orleans at Barataria Bayou, extending to lock location back of present Mississippi levee below Algiers. Lock location keeps through waterway traffic out of congested New Orleans harbor area.



TWO DIESEL-POWERED DRAGLINES with drop hammers and leads drove 5,898 piles for lock chamber and gate bay, as well as steel sheetpile cutoff walls. Pile-driving contractor, Keller Construction Corp., drove untreated pine piles with minimum tip diameter of 8 in. and lengths of 50 to 55 ft, through soft clay into 5-ft-thick sand stratum (Fig. 3). Pile tops extend 6 in. into concrete floor.

The soft compressible clay stratum in the foundation required the use of piles, which were designed to carry a load of 20 tons each. They were driven with a drop hammer after the excavation had been unwatered.

The lock structure is of reinforced concrete, inverted rigid-frame design (drydock type) with walls and floor slab acting as a unit in resisting imposed loads. The gate-bay floor is 10 ft thick, and the walls are 6 ft at the base, decreasing to 2 ft near the top. The lock chamber floor is $6\frac{1}{2}$ ft thick and the walls are $5\frac{1}{2}$ ft thick at the base, decreasing to 2 ft near the top. The allowable working stresses in the reinforced concrete were based on an ultimate compressive strength of 3,000 psi for concrete and a working stress of 18,000 psi for reinforcing steel.

In design, hydrostatic pressure or uplift on the structure was considered as acting on 100 percent of the base with full head to the saturation line. In order to reduce the possibility of swelling pressures against the walls, only selected sandy material will be used for backfill against the walls above El. 5.0. Although a number of design cases were investigated, the following were found to be governing ones:

Design Case I. Lock chamber unwatered; saturation line at El. 18.0 ft; uplift active; soil outside of footing assumed to shear off at 45-deg angle and earth wedges inside shear lines assumed active in resisting uplift. Sandy material used as backfill above El. 5.0 and drain installed to maintain saturation line at lowest practicable level. This case governs the thickness of the lock walls and the amount of reinforcing steel in the outside face of the wall. It is also the critical case as far as flotation of the structure is concerned.

Design Case II. Water in lock chamber to El. 0.0; saturation line at 18.0; uplift active. This case determines the amount of reinforcing steel in the bottom of the floor slab.

Design Case III. Water in lock chamber to El. 18.0; saturation line at 0.0; uplift active. Earth above El. 0.0 assumed to be shrunk away from wall. Earth thrust active below El. 0.0. This case determines thickness of floor slab and amount of reinforcing steel in top of slab and inside face of wall.

Model of Sector Gates Tested

Sector gates were adopted as the most desirable type since operating conditions are such that at times the gates will have to operate under a reverse head. This type of gate also permits filling and emptying the lock without resorting to valves and conduits in the lock walls. Filling and emptying will be accomplished by partially opening the gates and allowing the water to flow through the opening between the gates and also around each gate between the skin plate and the gate recess. A model study was made at the Waterways Experiment Station to check the filling time; to determine proper speeds for gate operation to reduce turbulence in the lock chamber to a minimum; and to hold to a low value the hawser stresses in the mooring lines of tows.

Gates are designed to withstand a positive head of 18.5 ft, or a reverse head of 5.0-ft water load, and a boat load of 120,000 lb. Gates will be of all-welded structural steel, 36 ft high with a radius of 38 ft 3 in., and each leaf will weigh about 110 tons. The water load on the skin plate will be transmitted to horizontal girders through vertical channels and the girder load will be transmitted through three vertical trusses and horizontal framings to the hinge and pintle. The skin plate will vary from $\frac{1}{2}$ in. at the bottom to $\frac{3}{8}$ in. at the top. The gate and superimposed loads are supported on a lower pintle ball of 27-in. diameter and an upper hinge ball of 14-in. diameter. Both pintle ball and hinge ball will be sup-

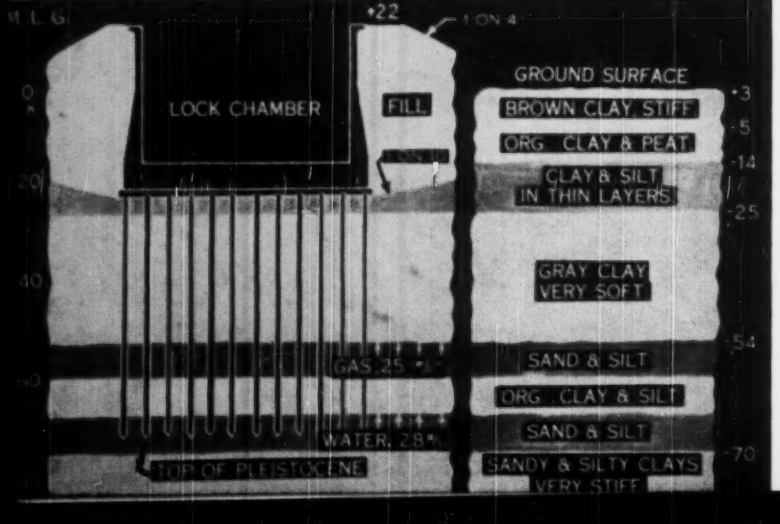


FIG. 3. AT ALGIERS lock site, borings extending down to El. −100 mlG (mean low Gulf level) showed need for pile foundations to carry loads through very soft clay to second sand layer overlying stiff Pleistocene formation. Top sand layer at El. −54 contained gas under pressure of 25 psi, and both sand layers contained water under pressure.

ported by castings attached to the masonry.

It was found that the gate machinery must be capable of operating over a wide range of variable speeds. Studies indicated that the best method of operation would be attained by hydraulically operated struts actuated by electrically driven pumps. For flexibility and speed of operation a variable displacement pump will be used for each leaf for slow speeds and a vane-type pump for high speeds. The machinery will be controlled by valves, relays, limit switches, interlocks, and float-driven selsyn units so as to provide semi-automatic operation. The lock operator will contol the gate movements from one switch with marked positions of "Open," "Close," and "Stop." Commercial electric power is available at the site for operation of the machinery and lights.

A stop-log type of emergency dam will be used to close the lock in the event of a major accident to the gates. Such an accident, allowing free flow of water through the lock during high stages of the Mississippi River, would be equivalent to a levee crevasse and would cause flooding of a large area. A 50-ton stiff-leg derrick will be erected at the riverside end of the Lock structure for placing the stop-logs; five stop-logs will be placed horizontally, one on top of another, to span the lock and effect a closure. Each stop-log will be built in a trussed-box section with a skin plate on the upstream side only. A timber guide wall will be provided at the entrance and exit of the lock to facilitate the lining up of tows before entering the lock or for tying up while waiting to enter.

Work Divided Into Smaller Contracts

At the time work on the Algiers Lock project was to be initiated, construction costs were relatively unstable and material and labor markets very uncertain. Most general contractors were reluctant to assume a long-term contract or one which involved a large financial commitment. Conferences with a number of construction firms indicated that it would be advantageous to construct the lock under several contracts of moderate size rather than under one general contract which would extend over several years. This plan has worked very satisfactorily and by minimizing the hazard assumed by the contractors, has resulted in a considerable saving to the government.

Excavation for the structure was performed under a contract with Inland Construction Co. Work under this contract consisted of removing about 137,000 cu yd of material by truck and excavating about 232,000 cu yd with a 10-in. diesel-powered hydraulic dredge. The dredge reached the site of the work from the Mississippi River, through the degraded river levee in an access channel which was constructed by government plant. The levee was then restored. The dredge left the site through the same channel and the levee was again restored by government plant. The structural excavation work was performed between June 2, 1947, and February 18, 1948.

A contract was awarded to the Keller Construction Corp. for the construction of the pile foundation for the lock and steel sheetpile cutoff walls. Under this contract 5,898 untreated pine piles varying in length from 50 to 55 ft were driven. The general spacing of the piles was 4 ft longitudinally and $4\frac{1}{2}$ ft transversely. Two pile drivers, mounted on diesel-powered draglines, were utilized. To minimize the effect of displacement which might have resulted from the driving operation, the pile foundation was started at the center of the structure and thence carried outward to the ends. Work under this contract was started December 12, 1947, and completed August 15, 1948.

Before the pile foundations were completed, a contract was awarded to Stevens Brothers and the Miller-Hutchinson Co., Inc., for construction of the reinforced concrete lock floor. Work under this contract was started August 11, 1948, and completed July 12, 1949. The work involved cutting off the foundation piles, pouring a 12-in. concrete seal course, and placing 33,279 cu yd of concrete and 7,171,000 lb of steel reinforcement in the lock floor. On May 11, 1949, a contract was awarded to the same contractors for construction of the lock walls. This contract will include all remaining concrete work (15,050 cu yd), retaining walls and wall armor. Work was initiated May 11, 1949, and as of December 31, 1949, was 51 percent complete. Completion is scheduled for June 16, 1950.

A contract for the lock gates will be advertised about February 1, 1950,

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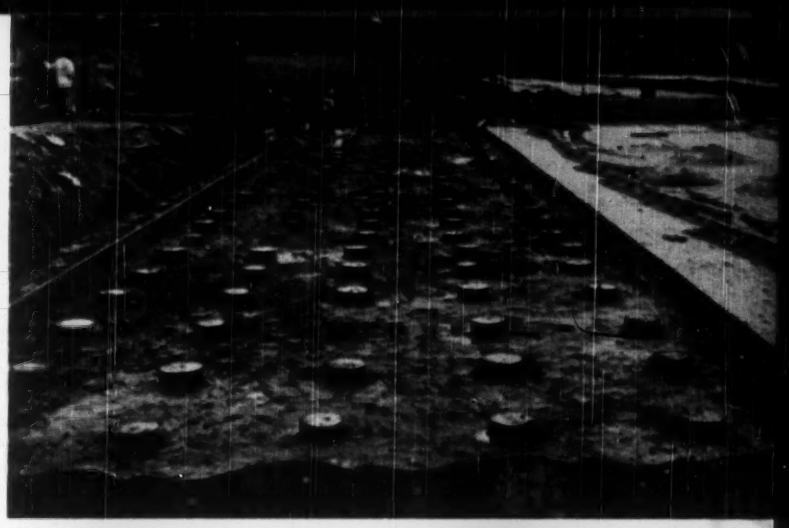
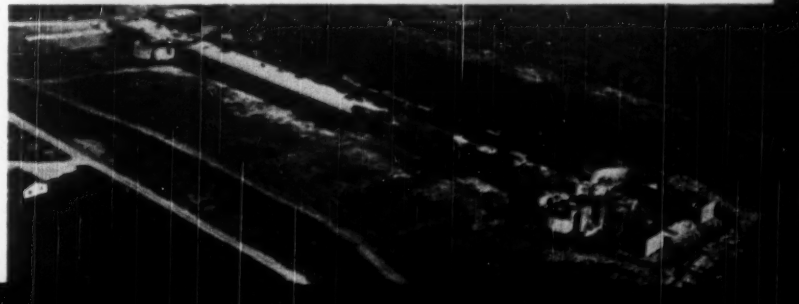


FOLLOWING PILE DRIVING, pile tops were cut off to grade and base stabilization slab of selected clay placed (center section). Next step was pouring of 12-in. concrete seal course, seen in place at right. Pile tops extend up into seal course about 6 in.



CONCRETING of Algiers lock chamber and gate bays was begun in August 1948 by Stevens Bros. and the Miller Hutchinson Co., Inc. By December 31, 1949, walls were half concreted, with completion scheduled for June 1950.

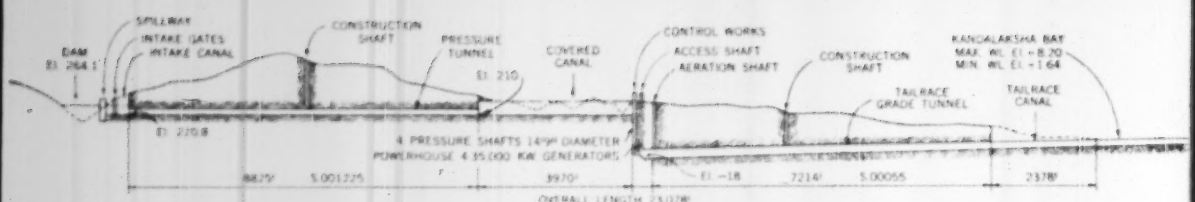


FIG. 1. ABOVE ARCTIC CIRCLE on Niva River, south of Murmansk, Russia, 200,000-hp hydro plant is placed underground. Power from available head of 243 ft is developed by four 35,000-kw units. There are neither geographic, climatic, nor topographic limitations on use of underground hydro plants.

Underground Hydroelectric Power Plants Have Economic and Operational Advantages

IN A CRITICAL review of 60 underground hydroelectric plants which have been built or are being built in the world and which have a combined installed capacity of over 7,000,000 hp, Joseph D. Lewin, M. ASCE, Board of Water Supply engineer of New York, N.Y., told the Power Division at the Annual Meeting of the Society that since the Buchberg-muehle plant in Germany was placed in operation in 1907, the rapid development of subterranean powerhouses all over the world seems to indicate not only their basic economic feasibility but their operational advantages.

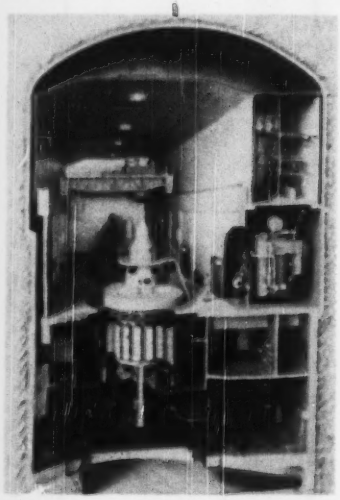
Built at All Elevations

It seems that there are neither geographic, climatic, nor topographic limitations on their use. From above the Arctic Circle, where the Swedish Porjus and Harspranget plants and the Russian Niva plant have been built, to southern Italy, where the Flumendosa plant is situated, from the Sulak in the eastern Caucasus to the Brommat and Baton plants in France, underground plants spot the globe. Even south of the Equator, in Peru and Australia, there are such developments. Underground power plants have been built at all elevations, from 7,000 ft above sea level to the Niva plant just south of Murmansk, which discharges below sea level into Kandalaksha Bay. (See Fig. 1.) The units range from a 31-hp unit in Friedigen, Germany, to a 2,800,000-kw development on the Snowy River in Australia.

Neither are underground power plants affected by considerations of hydrostatic head. They range from the 17.7-ft head plant at Friedigen to the 3,540-ft-head development at Tyin in Norway. Water quantities vary from the 15 cfs at Foce Ponale, in Italy, to the 14,200 cfs plant at Harspranget in Sweden.

These plants are built in all types of rock, igneous, sedimentary and metamorphic. Some are built in excellent, hard, sound rocks like the granites of Sweden, requiring practically no support; a few have been built in badly fissured, even disintegrated rocks, which required substantial and nearly continuous roof supports.

From the operational point of view, there are run-of-the-river plants and storage-fed plants; base-load and peak-load plants. There are even two pumped-storage plants—the Swiss Palue and the Italian Cogilmas. No matter how different these plants are in regard to size, location, layout and operation, they have one thing in common. They represent the most economical solution for the development of power resources at the particular site.



ECONOMY of underground plants, which cost up to 40 percent less than conventional surface developments, is due chiefly to utilization of rock as a structural material. Cutaway model shows installation of five 56,000-hp Oerlikon units in underground powerhouse at Innertkirchen, Switzerland.

Although underground hydro plants are more immune to aerial bombardment than surface plants, this consideration was not given much importance, since the majority of them were constructed before strategic bombing was developed during the last war. The original decision to place plants underground was primarily an economic one. An analysis shows that costs are as much as 40 percent less than conventional surface developments, most of the savings being due to shorter developments, elimination of penstocks and valves, and savings in tunnel linings. Rock is utilized as a structural material and made to carry loads. Underground developments require less operating expense; there is no painting, no roofing, no heating, and only a small depreciation charge. The cost of excavation is 80 per cent of the investment.

Economical Rock Excavation

The seemingly paradoxical fact that the underground developments are cheaper than surface developments can be attributed to more economical methods of excavating rock in Europe. Based on prevailing American labor costs, it appears that European tunneling methods may reduce the cost of rock excavation by as much as 60 percent.

By using light, high-speed Swedish Diesel-Atlas drills which weigh 35 to 55 lb each, and Sandvik Coromant drill steel, light jumbos and fewer men are required. Also less air—1,000 cfm per drill—is needed. Holes are smaller ($1^{3}/_{8}$-in. diameter), are close together, and the charge in each hole being smaller, the overbreakage is less and the roof supports lighter. Coromant drill steel is tipped

with a non-detachable tungsten-carbide chisel-shaped bit that can be sharpened only by grinding. It is claimed that a bit can drill 70 ft in hard granite before regrinding. An 18-ft hole can be drilled at a rate of 1 ft per min with one change of steel. The machine automatically drills a set number of feet, stops drilling, washes out the hole, retracts the drill steel and stops. One driller can operate two or more machines.

A new development in lining circular pressure tunnels is the use of prestressed concrete. The lining consists of precast blocks $1\frac{1}{2}$ to 4 in. thick, placed in the tunnel to form a full ring, which is then prestressed by high-tensile-strength steel loops or by high-pressure grouting in the space between the rock and the ring. The concrete is prestressed to a compression 50 percent higher than the expected tensile stress. The blocks may also be treated with asphalt to improve their watertightness and to reduce friction losses. The thin prestressed linings reduce the required excavation and contribute toward further savings.

Underground powerhouses are adapted to architectural treatment. The domed structures are suited to indirect lighting and air conditioning. A compact turbine generator unit has been designed by the Swiss Oerlikon Co. to decrease the over-all height of powerhouses and to simplify the support of the unit itself.

Radioactive Tracers, City-County Mapping, and Port Development Among Technical Meeting Subjects

Radioactive Tracers—Harold A. Thomas, Jr., and Ralph S. Archibald

Use of radioisotopes has several advantages over the previous methods of using salts and dyes for measuring horizontal mixing. So stated Harold A. Thomas, M. ASCE, and Ralph S. Archibald, Jun. ASCE, in their paper on "Radioactive Tracers in the Measurement of Longitudinal Mixing," delivered before the Sanitary Engineering Division at the Annual Meeting. Dr. Thomas is an Associate Professor of Sanitary Engineering in the Division of Engineering Sciences at Harvard University. Mr. Archibald, a sanitary engineer with the consulting engineering firm of Camp, Dresser, & McKee, of Boston, Mass., was a Research Fellow at Harvard at the time he did his work on the paper.

The foremost advantage of radioisotopes, the paper stated, is perhaps the fact that they can be detected in extremely small concentrations. A clear signal (100–1,000 radiations per minute) can be obtained from 10^{-10} or 10^{-11} milligrams per liter. These low concentrations do not cause observable density currents which may disturb flow patterns.

In addition, the presence of radioisotopes can be easily identified by modern Geiger counters of many types, which give precise results. Passage of tracer clouds can be detected through conduit walls, eliminating the necessity of sampling the flow. Further, no chemical or biochemical reaction occurring in the flow interferes with the rate of disintegration of the isotope; temperature changes have no effect; and the absorption of the tracer on solid surfaces can be made negligible by proper choice of isotope.

There are, of course, disadvantages involved, such as the great care required to protect laboratory personnel from overexposure to radiation, and in some instances the expense runs high when energy is dissipated during long shipping delays.

The tests which were run to determine the utility of radioisotopes as a tool of the hydraulician were conducted at Harvard University by Mr. Archibald, under the 1948 John R. Freeman Fellowship awarded by the Boston Society of Civil Engineers.

Mapping Cincinnati—H. H. Kranz

The City of Cincinnati in conjunction with Hamilton County, Ohio, has embarked on a comprehensive program designed to map the entire city-county area of 414 sq miles. In his paper describing the project, H. H. Kranz told the joint session of the Surveying and Mapping Division and the City Planning Division that the project would cost approximately $1,120,000.

The costs are shared by the City of Cincinnati and Hamilton County, each paying for the mapping of its own area, with the exception of a 3-mile band of county area contiguous to the city's corporation line, the cost of which is shared equally by both parties.

An excellent arrangement was made with the U.S. Coast & Geodetic Survey, under which the city paid the per diem costs of federal personnel, supplied a field engineer and engineer aids, and provided miscellaneous supplies, transportation costs, and the maintenance of federal vehicles. The U.S.C. & G.S. provided the loan of all the required precision instruments, two panel trucks, 14 Bilby steel towers, miscellaneous precision equipment, and the salaries of federal personnel. Mr. Kranz, who is City Engineer of Cincinnati, states that this arrangement was so completely satisfactory to the city that he unhesitatingly recommends it to other cities contemplating mapping programs.

Aerial survey methods were adopted as the most economical procedure, the contract going to Fairchild Aerial Surveys Inc.

Port of Baton Rouge—Leo M. Odom

As part of the future development of the Port of Baton Rouge, a canal is planned to run parallel with the river, between the bluffs and Devil's swamp. Leo M. Odom, M. ASCE, speaking before the Waterways Division, declared that a canal at this point would provide additional water frontage for the city along the bluffs. Spoil from the canal, used to fill the swamp, would also provide additional land on the river side of the canal. A much needed safe harbor out of the river traffic would be created which would be relatively free from silting, scour, and swift currents.

The second project of the Baton Rouge development program, Mr. Odom said, is the Port Allen connection, a new modern channel for the Intracoastal Waterway across the Mississippi. This channel would divert some of the heavy traffic from the already congested channels at New Orleans. An additional advantage is the fact that a connection at this point would save 160 miles in the length of haul to west Gulf ports on the waterway.

Congressional approval has already been received, but as yet no funds have been appropriated. Completion of these projects, stated Mr. Odom, who is consulting engineer for the Baton Rouge Port Development Association, will invite new industries to the Port of Baton Rouge and guarantee continued growth of the already booming river barge traffic.

Sanitary Engineers Face Problems Incident to Rapid Expansion in Field of Sanitation

Résumé of Paper Delivered Before Sanitary Engineering Division of ASCE at Annual Meeting

FRANKLIN THOMAS, Past-President, ASCE
Dean of Students, California Institute of Technology, Pasadena, Calif.

LIKE MANY other phases of the broad domain of civil engineering, sanitary engineering has undergone tremendous expansion in the first half of the Twentieth Century. As a result of this expansion special problems have been created, among the most prominent of which relate to: (1) The position of the sanitary engineer within ASCE, (2) the determination of who should be classed as a sanitary engineer, and (3) the type of education and training best suited for the sanitary engineer.

ASCE's Interest in Sanitary Engineering

With regard to the first of these questions, the January 1949 Progress Report of the Sanitary Engineering Division's Committee on the Advancement of Sanitary Engineering states that "Sanitary engineers have no single professional home. Because of their broad interests they are scattered through a dozen or more technical, scientific and engineering organizations." The Committee recommends that joint boards and councils of the various organized groups be established, with the ASCE serving as the stimulating and motivating agency to achieve the unity of purpose so urgently needed. The Committee believes that the formation of an independent society of sanitary engineers would probably serve little purpose.

While it is true that sanitary engineering is a specialized field, based on fundamental scientific training and related to many basic branches of engineering, its ties are primarily to civil engineering. The ASCE should take the leadership, or at least actively participate, in all joint committees of sanitary engineering such as those to establish water quality standards, standard specifications, criteria of stream pollution, educational policy, and programs for professional advancement.

Who Is a Sanitary Engineer?

The second problem created by rapid expansion in the field of sanitary engineering is the determination of who is a sanitary engineer and what lines of endeavor should be considered as sanitary engineering. The Committee report previously referred to lists three related fields—industrial hygiene, public-health engineering, and environmental sanitation. While many sanitary engineers may become involved with these fields, it does not follow that all who are engaged in these fields should be considered as sanitary engineers.

Industrial hygiene is sufficiently different from sanitary engineering to be classed as a separate profession, and the only reason why it has been linked with sanitary engineering is that both fields come under the supervision or control of public-health officials.

The term "public-health engineering" is unfortunate—the result of an attempt on the part of public-health officials, particularly the doctors of medicine, to place all professional and subprofessional personnel in all non-medical and non-pharmaceutical phases of public health in one group. The ASCE should continue its efforts to protect the professional standing of sanitary engineers and to resist all attempts to group them with non-professional personnel. The term "sanitary engineering" is sufficiently definitive of the position and activities of the profession; the terms "public-health engineer" and "public-health engineering" should be abolished.

Environmental sanitation is a broad term, including not only sanitary engineering but also industrial hygiene, air pollution control, inspection of milk and food handling, rural sanitation and all the other phases of the ill-termed public-health engineering. As commonly employed, however, the term environmental sanitation has come to mean rural sanitation and the inspection of food, milk handling, and restaurants. It is important work and it must be done, both by subprofessional personnel and by highly trained scientists, but most of it is not true sanitary engineering.

The Committee states that, "Programs of instruction in environmental sanitation are being developed in liberal arts colleges and even in some medical schools." The profession of sanitary engineering should be reserved first to engineers and secondly to those scientists concerned with water, waste, sewage, refuse, and pest control.

How Should Sanitary Engineers Be Educated?

The third problem concerns the education and training of sanitary engineers. There are some who feel that sanitary engineering should be classed as a separate and distinct field of engineering with independent specialized training on the undergraduate level. However, the present trend in engineering education is toward less rather than more undergraduate specialization, with the wholehearted support of industry and employers. Most of the schools consider sanitary engineering as an advanced phase of civil engineering, to be studied on the graduate level.

Many foremost sanitary engineers have developed from the pure sciences or from branches of engineering other than civil. It would seem, therefore, that the best undergraduate training would be a sound four-year curriculum in the fundamentals of science and engineering. In fact, in my opinion, such undergraduate training would be the best basis for all phases of civil engineering.

The Sanitary Engineering Division of the ASCE would do well to go on record as favoring a broader scientific undergraduate civil engineering curriculum and the transfer of intensive sanitary engineering studies to the graduate level.

The field of sanitary engineering has been very greatly benefited by the analysis and clarification of its scope and requirements carried out by the Committee on the Advancement of Sanitary Engineering of the Sanitary Engineering Division of ASCE, and the writer is indebted to its Progress Report of January 1949, previously referred to, for many of the ideas expressed in his paper. The entire Society should support the efforts of this committee in rendering engineering education more effective and in improving the status of sanitary engineers.

Lower Mississippi Valley Flood Control Projects Near Completion

Abstracts of Papers Delivered Before Waterways Division, ASCE Annual Meeting

Work of Mississippi River Commission Summarized

P. A. FERINGA, M. ASCE

Brigadier General, U.S. Corps of Engineers, President, Mississippi River Commission, Vicksburg, Miss.

FUNCTIONS of the Mississippi River Commission, as created by the Act of Congress of June 28, 1879, were to consider and mature a plan to correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River, improve it for navigation, prevent destructive floods, promote and facilitate commerce, trade and the postal service.

The Act provided that the Commission should consist of seven members: Three from the Corps of Engineers, of whom one would serve as President; one from the Coast and Geodetic Survey; and three from civil life, two of whom must be civil engineers. All members are appointed by the President with the advice and consent of the Senate. The present membership consists of Col. Ernest Graves; Col. Clark Kittrell; Rear Admiral Leo O. Colbert, Coast and Geodetic Survey; Edward Flad and DeWitt L. Pyburn, civil engineers; Albert L. Culbertson and the writer. With the exception of Mr. Culbertson, who is not an engineer, all are members of ASCE.

Work Deals with Lower Mississippi

Major problems to be solved were those of the river below Cairo, and while the surveys required by the Act were duly completed from Lake Itasca to the Gulf, the plans and operations of the Commission, with comparatively minor exceptions, have dealt with the Lower Mississippi and its alluvial valley. The actual construction work is handled in the same way as in an ordinary Corps of Engineers Division. There are three Districts set up within the boundaries of the Commission—Memphis, Vicksburg, and New Orleans.

The alluvial valley extends from Cape Girardeau, just above the mouth of the Ohio, to the Gulf of Mexico. It averages approximately 40 miles in width and contains approximately 20 million acres, much of which represents some of the most fertile land in the nation. The distance by river from Cairo, at the confluence of the Ohio and the Mississippi, to the Gulf, is roughly 1,000 miles.

Five Types of Flood Control Work

The flood control problem which confronts the Commission is to take care of a design flood estimated at 2,450,000 cfs between the mouth of the Ohio and the mouth of the Arkansas and at 3,000,000 cfs below that point. The design flood was deduced by determining the most severe combination of synchronous floods of the tributaries of the Mississippi that could be expected under logically assumable hydrologic conditions. The drainage area involved includes 41 percent of the United States, or 1,240,000 sq miles. The problem of flood control is met by five types of work:

1. **Overbank Floodways** to carry flows in excess of the safe capacity of the leveed river channel. The New Madrid Floodway, in Missouri, is complete and was used in 1937. The other floodways are in the State of Louisiana. The design flood, at the latitude of Angola, is 3,000,000 cfs. Design floods at various sections of the river are shown in Fig. 1 (next page). The safe capacity of the Mississippi River at New Orleans is 1,250,000 cfs. The Bonnet Carre Floodway above New Orleans has been designed to take care of 250,000 cfs, discharging directly into Lake Pontchartrain. Thus the Mississippi River, plus the Bonnet Carre Floodway, will take care of one-half of the design flood. The remainder must find its way to the Gulf of Mexico by means of the Atchafalaya Basin, including the West Atchafalaya Floodway (250,000 cfs), the Atchafalaya River (650,000 cfs), and the Morganza Floodway (600,000 cfs) (Fig. 2).

Bonnet Carre Floodway is complete and has been used successfully on two occasions, in 1937 and in 1945. The West Atchafalaya Floodway is complete and can be used if needed. The capacity of the Atchafalaya River is sufficient to take care of its share, and the Morganza Floodway is under construction. It is expected that the entire Atchafalaya Floodway—including the Morganza structure, the greater levees confining the flood flows, and the work below Morgan City—will be completed early in the calendar year 1953.

2. **Levees,** which have been and are being built to a height and cross section which will enable the Mississippi River to carry the design flood. There are 1,581 miles of Mississippi River levees. The levees will be 73 percent complete by June 1950.

3. **Bank Revetment,** installed to hold the river in place and to prevent it from wandering as it has done in the past. Continued meander would destroy levees, with resultant need for setbacks, and would regain some of the length taken away when the cutoffs were made. A total of 425 miles of revetment will be needed, of which 199 miles will be in place by the end of the 1950 fiscal year.

4. **Reservoirs,** which are constructed beyond the limits of the alluvial valley on tributary river systems, such as the Ohio, the Upper Mississippi, the Missouri, the White, the Arkansas, the Ouachita, the Red, and, within the alluvial valley itself, on the St. Francis and the Yazoo. The design flood at Cairo was adjusted to reflect the effects of reservoirs above that point.

5. **Cutoffs,** designed to shorten the course of the river and increase its slope and discharge capacity, are complete.

The articles which follow, presented before the Waterways Division at the New York Meeting of the Society, outline certain individual problems which are encountered and the types of construction which the Mississippi River Commission is employing to solve them.

Construction Started on $20,000,000 Morganza Control Structure

P. A. FERINGA, M. ASCE
Brig. Gen., U.S. Corps of Engineers, President, Mississippi River Commission

BENJAMIN F. MARX
Project Engineer, Mississippi River Commission

FLOOD WATERS entering the Morganza Floodway will be controlled by the Morganza Control Structure now under construction on the right descending bank of the Mississippi River, near Mile 280 above Head of Passes. This control structure will also act as a part of the main line levees of the Mississippi River. The gated part of the structure, 3,900 ft long, will be flanked by embankments between the floodway guide levees. The structure has been designed to pass a discharge of 600,000 cfs at project flood levels. Discharge will be controlled by means of double-leaf vertical slide gates. It will also support high-level crossings of the Texas and Pacific Railway and Louisiana State Highway No. 30.

Weir with 125 Bays

The concrete portion of the structure will consist of a concrete weir resting on 3,400 foundation piles 90 ft long, and will have 125 bays each with a clear span of 28 ft 3 in. between piers. These piers will support not only the guides for the steel gates and the rails for a gantry crane to be used to raise and lower the gates, but also the highway and railway, as shown in Fig. 3. A stilling basin will be provided and derrick stone and riprap will be placed adjacent to the structure to prevent erosion. Abutments will be built to connect with the embankment. The weir structure will require 125,000 cu yd of concrete. The embankment will contain about 5,200,000 cu yd of earth.

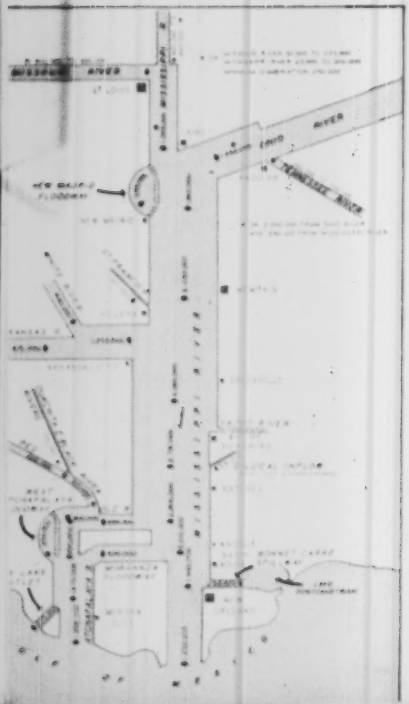


FIG. 1.—CONTROL STRUCTURES on Lower Mississippi are designed to distribute design flood of 3,000,000 cfs, as shown graphically by comparative width of channels.

Model Studies Conducted at Vicksburg

Because there were limited available data regarding the diversion of such large amounts of water through a structure of the type under consideration, model studies of the proposed structure were conducted at the Waterways Experiment Station at Vicksburg. These studies were used to determine the effect on stages, on flow distribution, and on the Mississippi River, as well as the hydraulic elements of the gated portion. These studies also indicated that, to obtain the maximum discharge, it would be necessary to clear the approach to the structure and about 1,250 acres of the floodway downstream.

Most of the borrow materials to be used in the construction of the embankments consist of high water-content, fat, inorganic plastic clays and silty clays. The natural water content of the soil during average summer months is 10 to 15 percent above the optimum for compaction. This material is slow to dry and is subject to shrinkage and cracking. Modified Proctor compaction tests indicate an optimum water content of about 23 percent and a dry density of 98 lb per cu ft for the silty clay materials, and an optimum water content of about 30 percent with a dry density of approximately 89 lb per cu ft for the clays.

For deep slides, which are the most critical, a minimum factor of safety of 1.2 was used in embankment design. Although this factor of safety is somewhat below that normally used, the stage construction to be employed will permit the foundation material to consolidate a considerable amount during the construction period. Existing embankments in the vicinity having similar cross sections are stable and show no indication of foundation failure; however, all embankments in this area undergo considerable foundation settlement for a few years following construction.

Embankment height varies from 30 to 33 ft. The crown will be 75 ft wide. The base width will vary from 300 to 550 ft. A typical embankment section appears in Fig. 3.

Because of the high water content of the materials available for embankment construction, drying of these materials so that they can be compacted by generally accepted means at or near optimum water content is impracticable. Therefore, the entire embankment, with the exception of the upper 3 to 5 ft, will be of the "semicompacted" type in which the materials are spread on the fill in layers not more than 12 in. thick prior to compaction, and subjected to at least three passes of a crawler-type tractor weighing at least 10 tons.

The upper 3 to 5 ft of embankment will be constructed of selected material of silty or sandy nature, compacted by tamping rollers. The ballast of the railway and the pavement of the highway will be placed directly on this selected material.

Estimated Foundation Settlement

Computations indicate that foundation settlement will probably range between 3.5 and 5 ft. It is estimated that 90 percent of the settlement should take place within 5 years following the beginning of construction.

As all investigations at this site indicated that excessive settlements would take place under a slab foundation, a pile foundation is considered necessary for the gated portion of the structure. Design pile loadings will be 90 tons in compression and 25 tons in tension. All piles will be driven to sand. The use of the high compression load is based on preliminary cost studies which indicated that, because of the length of the piles, a high loading would be cheaper than a lower one with correspondingly smaller size and greater number of piles.

In order that the bearing value of piles driven into the deep sand stratum might be determined, pairs of pipe piles having diameters of 12, 18, 24, and 30 in. were tested in

compression at a location near the center of the gated part of the structure. Also, one pair of steel-shell tapered piles having an 8-in tip and an 18-in. butt, and a pair of 22-in. square precast concrete piles were tested in compression. The compression tests were conducted in such a manner that the bearing capacity of the portion of the pile driven into the sand could be evaluated. This was done by testing compression piles in pairs, one driven into sand and one driven to terminate above the sand.

All piles drove easily through the clay strata and the driving resistance increased sharply when the pile tip encountered the sand stratum. The pipe piles were driven with closed ends. Pile loads were applied by hydraulic jacks. The reaction for compression loads was stacked dead weight. A total weight of 200 tons was placed over each pile not driven to sand and 400 tons over the piles driven into sand. The 400-ton test load in place over a pile is shown in an accompanying photograph. The dead weights were supported on timber pile bents driven on each side of the test pile. The reactions for the tension loads were furnished by eight timber piles located on each side of the test pile. The movement of the pile head was measured by dial gages on opposite sides of the pile and by levels.

Analyses indicate that a 20-in.-dia pile or its equivalent will be satisfactory to withstand a 90-ton compression load and more than ample to take care of the tension loading.

In an attempt to solve the problem of joining an abutment subject to settlement to a rigid structure, the abutment areas have been preloaded with an earth fill. It is expected that most of the settlement in the abutment areas will have occurred before the abutments are constructed and that most of the differential settlement will have been eliminated.

From a structural standpoint, the design of the combined control structure presented no problems that required departure from proved methods of analysis. The unit weights, pressures, and working stresses employed are based on the experience of the engineering profession and, in general, are in accordance with the Engineering Manual for Civil Works Construction issued by the Chief of Engineers, U.S. Army.

The railway bridge spans were designed by the Texas and Pacific Railway for Cooper's E-60 loading. The spans are the same as those used on the high-level crossing of the railway company's main line over the Morganza Floodway. The highway deck spans were designed by the State of Louisiana, Department of Highways. The design conforms to the standards of the American Association of State Highway Officials for an H 20-S16 loading. The roadway will be 26 ft in width with a 1-ft 6-in. walkway on each side. The crane bridge has been designed to sustain the dead weight of the loaded gantry crane with a 40-lb per sq ft wind load acting on the crane.

Two-Leaf Gates of Low-Alloy Steel

The gate openings will be 22.5 ft in height and 28.5 ft long. The gates will be raised, lowered, and transported with a traveling gantry crane. To reduce the height of the gantry and the gate storage facilities, the gates will be divided into two leaves of approximately equal height. Each leaf will be provided with rollers operating on tracks or guides of corrosion-resisting steel located in recesses in each pier. Rubber seals will be provided to seal the space between the leaves, between the gates and the piers, and between the lower gate and the weir. The gate leaves will be stored in the gate guides in their raised position and will be supported by semiautomatic dogging devices located at the top of the guides.

For reasons of weight reduction and economy, the gates will be constructed of high-strength, low-alloy structural steel, welded throughout. The lifting beam is so designed that the gates can be hooked and unhooked from the cab of the gantry crane by remote control. The gantry crane will be powered with a self-contained gasoline-engine-driven generator unit. At one end of the gantry, a jib crane will be provided for handling drift and for other uses requiring lifting outside the limits of the gantry.

Because uninterrupted traffic must be maintained on the existing highway and railway located immediately east of the control structure, and

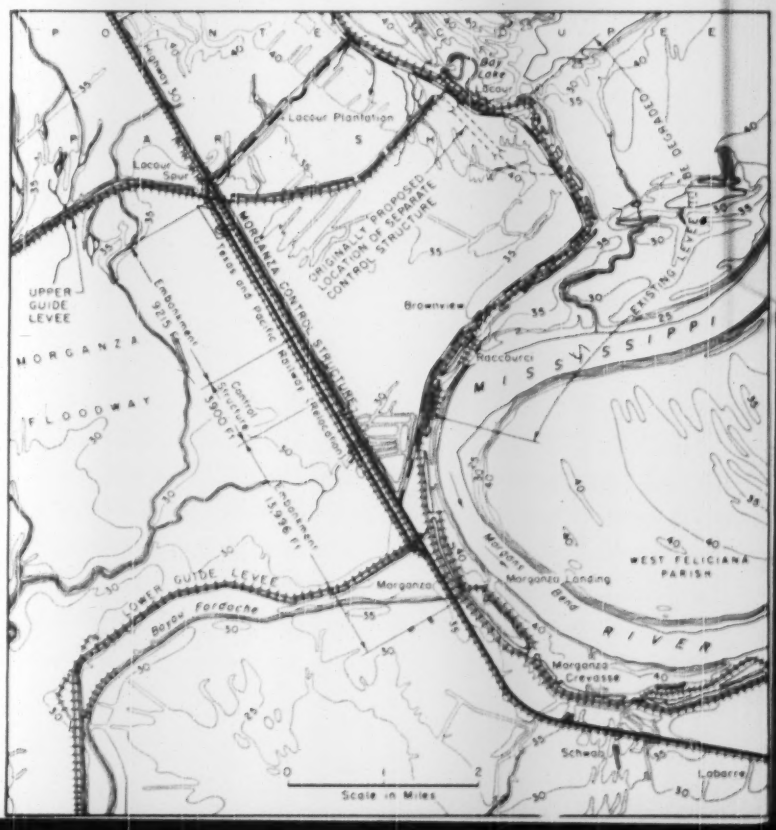


FIG. 2. MISSISSIPPI RIVER and Bonnet Carre Floodway together can carry only half of design flood of 3,000,000 cfs. Other half must reach Gulf through Atchafalaya Basin. Atchafalaya River can take care of 650,000 cfs, and West Atchafalaya Floodway, already completed, can pass 250,000 cfs, leaving 600,000 cfs for Morganza Floodway. Until Morganza control gates are in place, Morganza Floodway will be operated when necessary by breaching main river levee.

because the embankment when completed will envelop the existing railway, it will be necessary to construct the structure, particularly the embankment, in a number of steps or phases in order to maintain an orderly and economical construction procedure. To date, work on the structure has consisted of the pile testing program, and initiation of the first contract for embankment construction under the plan indicated in the embankment cross section in Fig. 3, where the embankment portion recently initiated is designated as Phase I. This consists of the semicompacted fill from the west shoulder of the existing railway embankment to the downstream, or western toe, of the proposed embankment. This work is being done under contract by Grenada Dam Constructors of Mississippi. It is estimated that this construction will require two working seasons and will not be completed until late in 1950 or early in 1951.

It is planned to start construction of the gated part of the structure in the spring or summer of 1950, work which is estimated to require two to three years. It is also estimated that the railway bridge spans will be ready to receive ballast and track early in 1952. Gates and gantry cranes will be purchased by the Government under supply contracts for installation by the contractor.

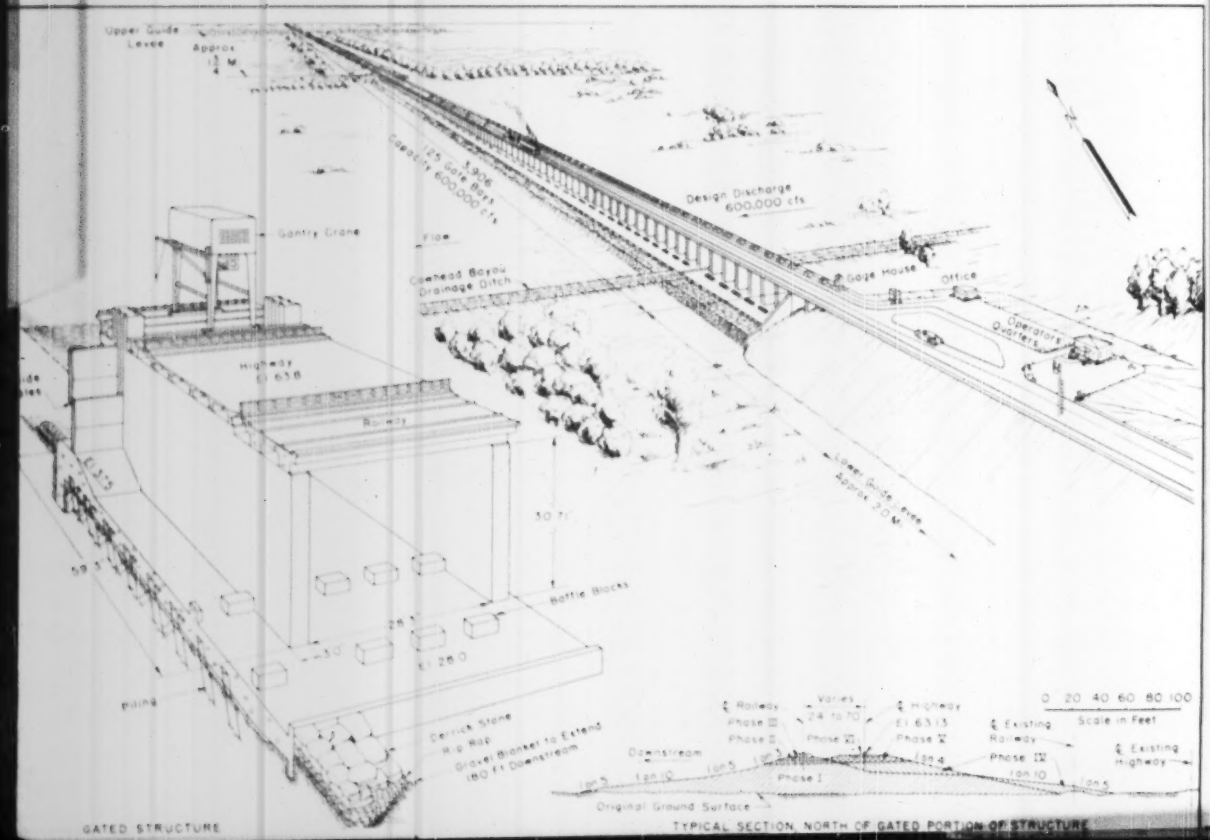
In the spring of 1951 a contract will be entered into for construction of Phase II of the embankment, which will consist of placement of selected material on the western side of the embankment to complete the railway subgrade. This work should be completed by the end of 1951. Construction of track and ballast (Phase III) by the Texas and Pacific Railway will be initiated in the spring of 1952 and should be completed in the late summer or early fall of that year. The railway can then begin operations over the new structure and the existing line can be removed.

Completion of the semicompacted fill in Phase IV will be initiated as soon as the contractor can begin operations following removal of the existing track and appurtenances. This work is expected to be completed late in 1952 or early in 1953. As soon as the final stage of the semicompacted embankment has progressed to a point where placing of the selected topping material for the highway subgrade can be started, a contract will be entered into for this part of the work, Phase V. Estimates indicate that this work will be completed in the summer of 1953.

The gated part of the structure, including riprap paving and incidental work, will be completed early in 1953, except for that part of the training walls which will encroach on the existing highway.

As soon as construction of the selected topping material of the highway subgrade has progressed to a stage where construction of the base course for the temporary flexible pavement can be initiated, this work will be begun by the State of Louisiana, Department of Highways, with a view

FIG. 3. ENTRANCE to Morganza Floodway is controlled by gated weir structure designed to pass 600,000 cfs, with embankment approaches at each end. Gated section will rest on 3,400 twenty-inch piles driven 90 ft to bearing in thick sand stratum. Approach fills are now under construction by Grenada Dam Constructors, Inc. Completion of floodway control structure is planned for 1953.



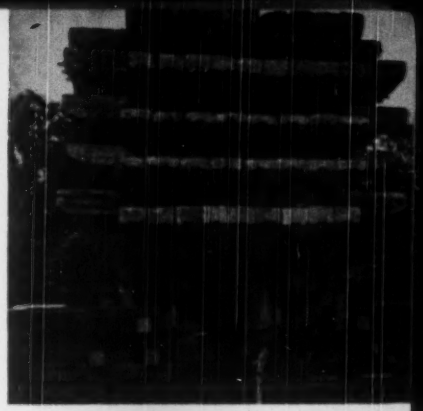
to completing the temporary pavement in the late fall of 1953 or early in 1954.

On completion of the temporary pavement, highway traffic can be diverted over the control structure and the small amount of construction that will encroach on the existing highway can be completed. Then the degrading of the existing main-line levee along the west side of the Mississippi River that now crosses the forebay of the structure (indicated in Fig. 1) can be started. When the degrading of this levee is completed, the Morganza Floodway Structure will become a portion of the main-line levee system of the Mississippi. In this stage it will be ready for operation.

Total Cost Estimated at $20,000,000

Construction of the embankment portions of the structure will cost about $2,750,000, and the gated portion about $16,000,000. The work to be performed by the Texas and Pacific Railway and the State of Louisiana, Department of Highways, exclusive of deferred construction, will amount to about $1,000,000. Degrading of the main-line levee of the Mississippi River and clearing in the floodway will be about $900,000, depending on the elevation to which the levee will be degraded. Thus the total cost of the work will be approximately $20,000,000.

Pending completion of the control structure at Morganza, the plan is to open the Bonnet Carre Spillway first; then, if necessary, the Morganza Floodway will be placed in operation by artificially crevassing the main-line levee at its head. The Morganza Floodway would be opened as soon as practicable after predictions indicate that a stage of 20 ft at New Orleans will be exceeded, which corresponds to a discharge of about 1,250,000 cfs. The West Atchafalaya Floodway, which admits water at the head of the leveed area west of the Atchafalaya River, will be operated as necessary after both the Morganza and the Bonnet Carre Floodways have been placed in operation. This floodway would be operated in this manner under both the interim and the final plans of operation.



TEST PILE for Morganza control-gate foundations supports 400 tons when driven 90 ft to firm sand stratum and loaded by jacking against stacked dead weight. Tentative design load on 20-in. piles is 90 tons each.

Main Mississippi River Levee System 80 Percent Complete

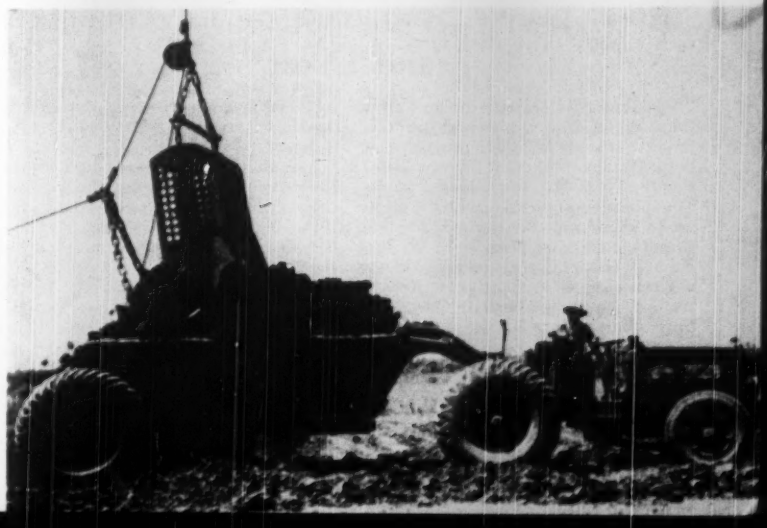
An area approximately equal to the state of Maine, 30,000 to 35,000 sq miles, is subject to overflow by the Mississippi River in a state of nature," Charles Senour, M. ASCE, Chief Engineering Assistant, office of the President, Mississippi River Commission, and R. A. Latimer, Head Engineer of the Commission, told the Waterways Division at the ASCE Annual Meeting. They said it is planned to protect about 23,500 sq miles against all floods and an additional 4,000 sq miles or so against all but the most severe floods. Briefly the plan is to confine the design flood to the channel of the river by levees from the head of the alluvial valley to the mouth of the Red River, except for a short stretch above New Madrid, Mo., where an auxiliary side floodway is employed. Below Red River the design flood is to be carried jointly by the Mississipppi River and the Atchafalaya River and the Atchafalaya Basin floodways. The project also provides for the maintenance of open-river navigation by dredging.

The levee system is about 55 percent completed. When finished it will have an aggregate length of 3,500 miles, of which 1,581 will be on the main river and the remainder on tributaries, outlets, and floodways. The cubic content will be about 1½ billion cu yd—more than five times the excavation required for the Panama Canal.

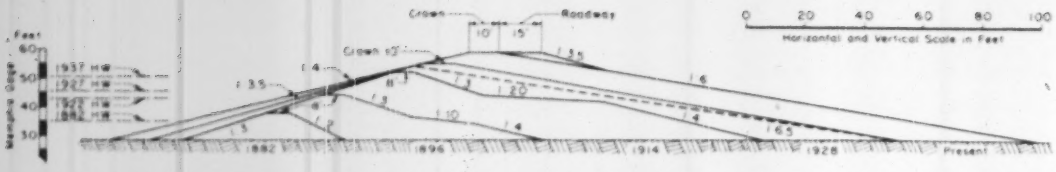
Of the 1,581 miles of main-line Mississippi River levees, 1,220 miles have been completed or are under construction to project grade and section. Similarly, some 690 miles of the 1,985 miles of backwater, tributary, and floodway levees are under way or completed.

The main-line levees could probably carry a record flood with moderate emergency operations, but most of the tributary levees are inadequate to carry floods even closely approaching project heights.

The river now has been largely "walled in" by levees. Many of them still remain to be brought to project grade and cross section but except for some recently authorized extensions to protect a narrow basin between the river and the east



DRAGLINE LOADS 14-cu yd Euclid Tractruk with earth for levee building.



LEVEE CROSS SECTIONS show development of construction practice under Mississippi River Commission since 1882. Scale at left indicates flood crest stages on Memphis gage

escarpment north of Memphis, those on the main stem are on the whole practically complete as to linear extent. The levee line on the west bank begins just south of Cape Girardeau, Mo., and except for gaps at the junctions of the St. Francis, the Arkansas-White and the Red-Atchafalaya Rivers, extends unbroken almost to the Gulf of Mexico. The east bank of the river is protected by levees alternating with high bluffs.

Under the project adopted by the Act of May 15, 1928, grades below Cairo, Ill., have been established in general at 1 ft above the computed flow line of the maximum probable flood. The computed average frequency of occurrence of the design flood is once in about 370 years. The greatest flood of record has a computed frequency of about 80 years.

At the present time three types of main-line levee sections are employed:

1. For a fill compacted to maximum density at optimum moisture, the width of crown is 10 ft, river-side slope 1:3½, land-side slope 1:4½.

2. For a fill having a moderate degree of compaction at natural moisture content, and for uncompacted fills that are too wet for compaction, the width of crown is 10 ft, the river-side slope 1:4, and the land-side slope 1:5½ for levees less than 25 ft in height and 1 on 6 for levees 25 ft or higher.

3. For uncompacted fills of relatively dry material, the width of crown is 10 ft, river-side slope 1:4½, land-side slope 1:6½.

For purposes of inspection and flood fighting, a roadway along the crown of the levee is provided by extending the crown landward practically horizontally for an additional 15 ft, with the fill sloping thence at 1:3½ to intersect the land-side slope of the embankment. Levee heights range from a few feet to over 50 ft (through depressions) with an average of about 26 ft.

Long-boom draglines are still used extensively on work below the Red River and on the tributaries. Boom lengths range up to 175 ft and buckets up to 6 to 8 cu yd in capacity. These draglines are best adapted to work where the length of haul does not exceed 400 ft, but often are operated in tandem on work with a longer haul.

The tower excavator as used on Mississippi levees is essentially a slack cableway supported by a "head" tower 120 to 140 ft in height, carrying the operating machinery and stationed landward of the levee, and a "tail" tower 20 to 45 ft high riverward of the borrow pit. The bottomless bucket of 12- to 16-cu yd capacity operates without rehaul cable up to spans of about 700 ft. The tower excavator is best adapted to work where the haul does not exceed 1,000 ft, and successive enlargements of the levee have now increased the width of adjacent borrow pits to such an extent that the location of available material for future work is generally beyond its economical range.

Present-day hauling equipment consists of tractor-drawn crawler-type dump wagons, rubber-tired Euclids and dump trucks, and mechanized scrapers. Wagons, Euclids and dump trucks are usually loaded by dragline, although in some instances the elevating grader is still used when the borrow-pit area is free of timber and stumps and the borrow-pit material comparatively dry. The dragline is generally equipped with a boom from 45 to 50 ft in length and a bucket with a capacity up to 4 cu yd.

After the levee embankment is built to the required height and dimensions, the entire surface is smoothly dressed and planted or seeded with Bermuda or some other acceptable grass which will best meet the climatic conditions.

River Banks Stabilized by Revetments and Dikes

"AGGRAVATED BY wide variations of hydrographic and physiographic elements, the problem of bank stabilization on the lower Mississippi River has been found to be extremely complex," stated Raymond H. Haas, chief, Bank Protection Branch, and Harvill E. Weller, chief, Dikes Section, Mississippi River Commission, in a paper presented to the Waterways Division in New York. Since the problem is primarily one of arresting bank recession, revetment is the principal structure employed. Dikes, retards, and grouns are being installed to a lesser extent, depending on the particular situation encountered.

These bank protection structures have been developed by theory and experience during a period of more than 70 years. For the most part the details of their design are peculiar to the lower river, where the protection of the banks is progressing in a systematic manner with a view to artificially modifying the primitive stream for the purpose of securing effective flood control and navigation.

As of January 1950 there are approximately 172 miles of stabilized banks on the Lower Mississippi River between Cairo, Ill., and Baton Rouge, La. Approximately 266 miles of caving bank remain to be stabilized, the greater part of which will be protected by articulated concrete revetment and about 13 miles by dikes, retards, and grouns.

Banks of the Mississippi River are inherently unstable, being composed of finely divided clays and silts overlaying easily erodible sands. Bank recession may vary from a few feet annually to more than 1,500 ft in some isolated cases. It has been computed that the caving banks between Cairo, Ill., and Donaldsonville, La., yield annually about 1,000,000 cu yd of material per mile. The

amount of silt in suspension is of only secondary importance, since, although it has been variously estimated as between 300,000,000 and 400,000,000 cu yd annually, it is probably transported in one continuous journey from its source to the Gulf. The major part of the material from a caving bank, however, forms an accretionary deposit immediately below its source. As the bank in a concave bend continues to recede, the point bar below enlarges and consequently aggravates bank caving conditions in the next bend below. Therefore the basic difficulty to be overcome in bank stabilization on the Lower Mississippi River is the instability of the river itself.

A revetment consists of two distinct parts—that below normal low water, known as the mattress, and that extending from the mattress to the top of the bank, called bank paving. The mattress comprises roughly three-fourths to four-fifths of the entire structure. Revetment construction normally follows a sequence of bank clearing and grubbing, clearing the under-water slope of snags, bank grading, mattress sinking, and finally bank paving.

Articulated Concrete Mattress Best

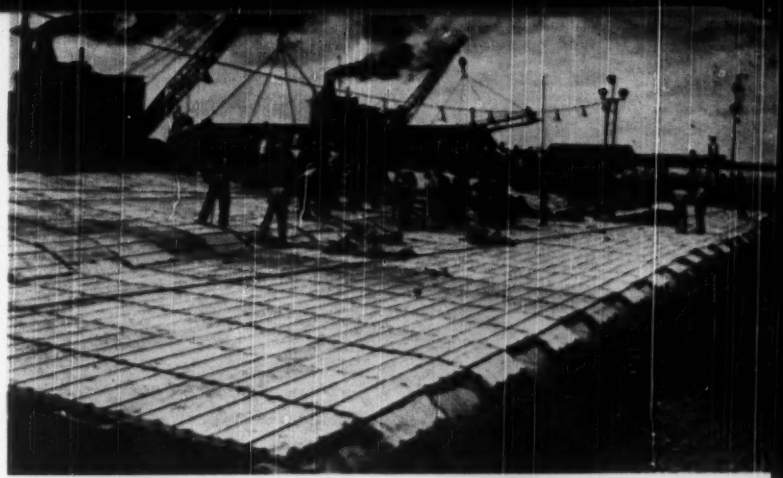
The present standard type of articulated concrete mattress is composed of precast units 25 ft long by 4 ft wide and 3 in. thick. Each unit has 20 individual blocks 14 in. wide, spaced approximately 1 in. apart, on heavy corrosion-resisting reinforcing fabric which is continuous throughout the unit. The precast units are assembled on the sloping deck of a launching barge; they are united by wire-rope clips and twist wires to each other and to the launching cables, the barge is then moved riverward 25 ft to allow the joined units to slide off the curved launching apron. The mattress hangs suspended in the water on its launching cables until the next section of slabs is attached to it and launched. This process is repeated until a complete mattress of any desired width has been constructed. The cables are then cut and the plant moved upstream into position for laying the next mattress.

The articulated concrete mattress is the best revetment yet devised, and the only type that can be placed at the rate required for the proper prosecution of the stabilization program. Three complete revetment construction plants, specially designed to place the articulated concrete mattress, are now operating on the lower river. The normal combined capacity of these three plants is 140,000 squares, that is, 14,000,000 sq ft of mattress per month. During a normal low-water construction season of five months, these plants are capable of revetting 40 miles of bank with a mattress averaging 350 ft in width.

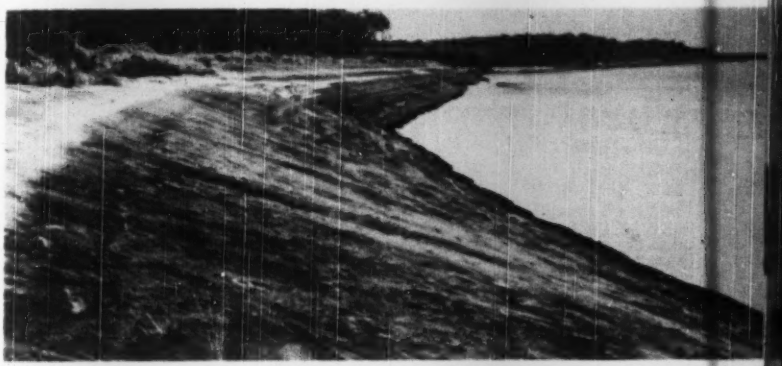
Stone has been adopted as the standard material for bank paving. A 10-in. riprap paving is able to adjust itself faithfully to irregularities in the slope and to reform and continue to give protection in the event of minor bank subsidence and sloughing. A pavement that cannot mold itself to such settlements fails in local areas and requires costly maintenance. Riprap paving is considered to be the best yet discovered but because of the local unavailability of stone, is little used below Memphis.

In 1945 an uncompacted, porous asphalt pavement was developed which is now in general use below Memphis. This pavement is placed on the prepared bank to a minimum thickness of 5 in. It is composed of about 94 percent bar-run sand and gravels and 6 percent asphaltic cement. The aggregates are heated to a temperature of 400 deg F ± 20 deg, as they are introduced into the mixer. The asphalt cement is heated to not more than 325 deg F.

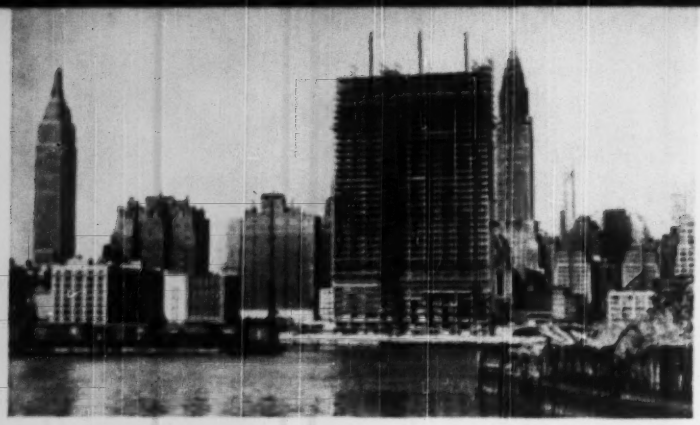
The degree of porosity obtained can be governed by the addition of a small amount of pea gravel to the mix. When bar-run sands alone are used the porosity of the finished pavement is about the same as that of loose sand. Because of its porosity, the uncompacted asphalt pavement does not impound groundwater and it is therefore a more acceptable pavement than either the monolithic concrete or the compacted asphalt.



STANDARD MATTRESS is of articulated concrete, composed of precast units 25 ft long by 4 ft wide and 3 in. thick, spaced about 1 in. apart on heavy corrosion-resisting reinforcing fabric. Precast units are assembled on sloping deck of launching barge which then moves riverward 25 ft to allow mattress to slide off curved launching apron. Mattress hangs suspended on its cables until next section is attached to it and launched. Concrete "fingers" at right reach above water's edge, and wires show method of anchorage.



UPPER BANK PAVING of asphalt prevents erosion above articulated concrete mattress. Uncompacted porous pavement, developed in 1945 and now in general use below Memphis, is composed of about 94 percent bar-run sand and gravel and 6 percent asphaltic cement.



UN SECRETARIAT BUILDING rises against backdrop of New York skyscrapers. Anchored to bedrock, building runs plumb for entire 42-story height (39 stories above ground), requiring critical exactness in location of marble panels in north and south walls and aluminum frames for all-glass east and west facades.

Builders View Problems of Constructing United Nations Headquarters

Paper Presented Before Construction Division at Annual Meeting

LOU R. CRANDALL

President, Fuller-Turner-Walsh-Slattery, Inc., and George A. Fuller Company

CONSTRUCTION PROBLEMS involved in building the United Nations Headquarters made it apparent from the beginning that a group of leading contractors, operating under coordinated management, was the best modus operandi. Such a combination would make available the best in experienced staff, manpower and management. With all the work being done by one such organization, orderly processes would replace what would otherwise be widespread confusion in such items as procurement, delivery and storage of huge quantities of material; awarding of subcontracts for the divisions of the work; coordination of the work with city-proposed changes in utilities made necessary by the project; uniform regulation of labor and of safety measures at the site; and the coordination of the numerous operations with one another, which is so vitally necessary on a project of this character.

Lump-Sum Contract Awarded

A proposal was submitted by Fuller-Turner-Walsh-Slattery, Inc. It was accepted and a contract was signed to accomplish the first section of the work for a lump sum.

The corporation is managed through an operating committee composed of the president and one other member from each of the four firms, namely: the George A. Fuller Company, the Turner Construction Company, the Walsh Construction Company and the Slattery Contracting Company, Inc. Responsibility and authority were specifically delegated to the various members of this operating committee for certain duties and as a whole this committee decides matters of organization and policy.

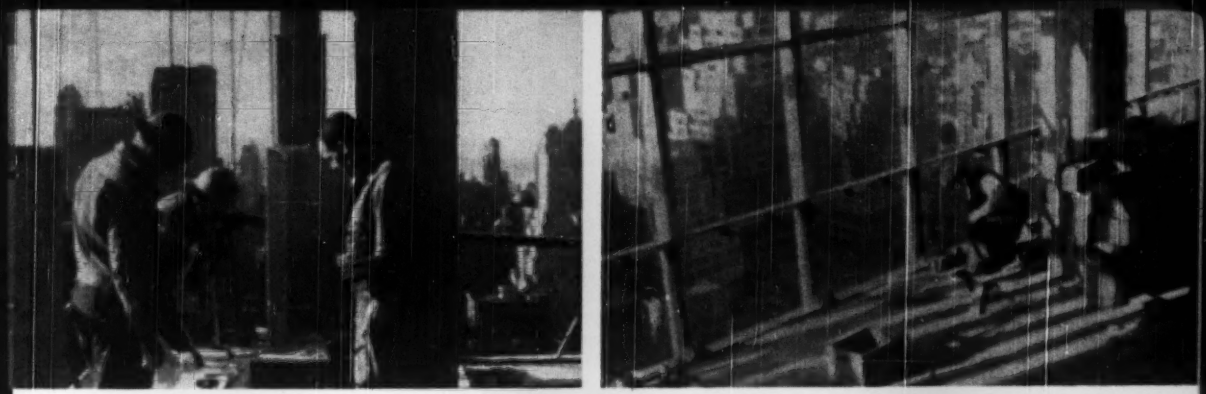
All work at the site is under the direction of a project manager, who is assisted by a project engineer, a general superintendent and an office manager. The project engineer is in charge of all matters relative to drawings and specifications, changes, dealings with subcontractors from a business standpoint, and supply, purchase and delivery of materials. The general superintendent is in charge of the field forces and coordination of all work, subcontractors or otherwise. He is responsible for the general housekeeping and safety precautions throughout the site. The office manager is in charge of all accounting and the general operation of the office.

The work covered by the first building contract includes: (1) the principal building (the 39-story and three-basement Secretariat); (2) the foundations, including concrete slabs on the ground and the exterior walls below First Avenue, for the Secretariat, the Meeting Halls, the General Assembly and the North and South (three-story underground) Parking Garages; (3) the service road located just west of Franklin D. Roosevelt Drive and extending the full length of the site; and (4) the foundations for the elevated cover over the Drive. Demolition of the existing building and general excavation were completed under a previous separate contract.

Most engineers are familiar with the general details and size of the Secretariat Building so I will not elaborate on this but rather on four basic problems in connection with the erection of this building which I feel will be of interest. The first of these problems resulted from the poor quality of rock found, after excavating, to underlie the easterly side of the Secretariat Building. Good bearing rock was found at a much lower depth than the borings indicated. Secondly, the design of and use of materials in this building were such that we did not have the usual tolerance in the plumbness of the steel. The third problem was concerned with the method of setting and supporting the marble. The fourth problem related to the complications involved in keeping such huge expanses of glass window grids truly straight and plumb. I will take up these problems one by one.

From the builders' standpoint, the piling and footings did not present any new or difficult problems in execution but did involve problems of design due to varying conditions on different parts of the lot.

The foundation conditions had a large influence on the location of the buildings. First of all, it must be remembered that many years ago



MARBLE PANELS placed by workmen (above, left) on south face of Secretariat have all panel joints pointed with plastic calking to allow free movement of slabs. These "soft joints" in north and south walls permit panels to move freely and avoid any crushing stresses set up by movement of steel frame. In all-glass east and west walls, each aluminum grid frame holding panes is attached independently to building frame (above, right), thus avoiding referred stresses. Aluminum grids were shop fabricated, with attaching brackets fitted to template exactness. Bolts which fasten frame to building were located by precise survey methods, and fastened with stud welder. Each grid is glazed with large-plate, solar-heat-resistant glass.

the line of the river was west of what is now the East River Drive and all of the drive at this point is now on deep fill. The rest of the lot, from the old water edge to First Avenue, was covered with a coarse mica rock in which the flakes of mica were quite large. This is true for all of the lot except one section north of Forty-fifth Street known as the Turtle Bay area where a creek, which at one time drained the southerly end of Central Park, had apparently eroded the rock for a considerable width and depth back from the main river channel. This Turtle Bay area was quite deep, ranging from 20 ft at one end to nearly 100 ft at the river and, as a matter of fact, we are told that on its shore at one time were a saw mill and a small shipyard, and that a British frigate was sunk in what is now part of this United Nations site.

Because of this Turtle Bay area, the buildings were all set to the south. It was decided early that none of the main buildings would have a composite type of foundation if it could possibly be avoided and that they would be set either on concrete piers to rock or set entirely on piling, but not on a combination of the two. This has been feasible with the exception of a small neck of the Meeting Halls where they join the Secretariat Building. The Secretariat and General Assembly will be on concrete piers while the Meeting Halls will be on piling.

Change in Foundation Design

In keeping these buildings south of the Turtle Bay area it happened that the eastward edge of the Secretariat Building came very close to the edge of the rock where water had once been against it. It was hoped that this building could be on concrete piers generally about 10 ft square, that these piers would be rather short and of fairly uniform depth.

The engineers, Moran, Proctor, Freeman and Mueser, changed this radically when we really got to excavating the east edge of this rock as it was evident that a greater amount of disintegration and altering had taken place in the edge of this rock where the river was at one time up against it than anyone could have contemplated. The character and extent of this weathering action was such that the engineers directed digging to a depth of about 35 ft, where they got hard ringing rock. This weathering alteration took place mainly under the outer row of footings for this building and did not extend westward more than a few feet. The remainder of the footings were in solid rock nearer the surface but the engineers felt that to have three lines of short piers and one deep one was bad design and that it was safer and better for all if the two center lines of piers were lowered so that they gave a proper angle in relation to the outside row and to each other. This caused some extra delay and cost but I feel sure it will prove to have been well spent.

Special Plumbing Technique Used

It must be remembered that this building starts from the ground level and runs plumb its entire height. There are no big bases or setbacks. Likewise, it is modern in design and the success of this type of architecture depends on the accuracy of its plane surfaces. There are no ornaments, cornices, reveals or recesses in this building which in the old conventional type of building enable us to overcome and correct inaccuracies. Consequently, we did not have the tolerances in plumbing and alignment that we have in ordinary buildings. Furthermore, with the critical exactness demanded in the location of the marble walls and the aluminum frames, which exactness depended in turn to a great extent on the true plumbing of the steel frame, a comprehensive system of survey controls was mandatory.

For the plumbing of the steel, observations were made at the splice level of all exterior columns, about 2 ft above the finished floor, at every other floor, the columns being two stories long. Using a special transit of high magnifying power with sensitive levels and a periscopic eyepiece, points were projected vertically upward from points on the ground to each floor as it was erected. Below the eighth floor the points were 4 ft outside the column centers, and above the eighth floor, the offset was changed to 2 ft inside the column lines, as the protection and catch-all scaffolds obscured the line of sight. To eliminate errors due to adjustment of the instrument in sighting to these high elevations the points were set up with the telescope both direct and reversed, and the mean point taken.

Levels were also taken at every splice plate for fear there might be slight errors in fabrication causing changes in the over-all length. The effect on plumbing caused by one or more columns being only a fraction of an inch too long or too short can readily be appreciated. Fortunately, the American Bridge Company kept abreast of these various levels so that it was not necessary to remill one column once they were on the job. There were cases of reaming rivet holes where they were attached to the beams. A final check of the location of the columns was made by transit after riveting to assure that the steel was well within the narrow tolerance permitted under these conditions.

These observations were made after regular working hours when all derricks and engines were not working. After the observations with the transit had been made, all deviations of the columns from the theoretical center lines were reported by means of diagrams to the steel erector, who corrected such errors before riveting.

In the cases of the windows and the marble walls, problems of design as well as installation were involved. The best procedure to follow in the case of the marble in the north and south sheer blank walls occasioned many conferences to determine just how this should be set and carried. It was finally decided to carry it from floor to floor with a soft joint under each floor. This follows a practice long established in skyscraper erection of building exterior walls floor by floor and keeping them separate from each other. We went somewhat further than the old practice when we added a really soft joint. The marble slabs rest on bondstones set on spandrel beams. The soft joint occurs under each bondstone. There are also four vertical expansion joints. All these joints are filled with plastic calking material so as to allow free movement of the panels. By isolating the panels in this way each one can move with a spandrel beam and be free from any crushing stresses set up by the thermal or wind stresses in the structural frame.

We gave the matter of correct setting of the marble on the survey points the same attention, and used the same methods in erection as we did with the steel.

In order to gage the thickness of the soft marble joints correctly, it was necessary to calculate carefully the shrinkage in the height of the building due to compression in the steel columns caused by the superimposed loads such as floors, partitions, and walls. These soft joints do not take their full compression, of course, until the building is completely loaded down. Although the total shrinkage amounted to about 2 in. in the height of the building, this caused no concern because it occurred gradually as the load went on and it was quite uniformly distributed throughout the height of the building and was taken up in these soft joints.

Keeping Windows in One Plane

The east and west elevations of the Secretariat, except for a 3-ft 6-in. marble return at each end, are made up entirely of aluminum grids in 4 × 12-ft sections. Each grid is composed of a fixed glazed spandrel and a double-hung window. During consideration of the principal architectural features to be incorporated in the building, Wallace K. Harrison, M. ASCE (Director of Planning for the UN), fully appreciated the practical difficulties involved in keeping such a vast unbroken expanse of windows in one plane. He told me he was hesitant about using that type of construction because he knew that the least deviation from perfect alignment would be very much magnified and apparent to the casual observer.

This, our fourth problem, was solved in a manner similar to that used in placing the marble panels of the north and south walls. This procedure involved attaching each grid frame independently to the framework of the building so that there is no referred stress from one frame to another. Weather-tight calked joints are provided between the frames, while retaining sufficient flexibility to permit independent movement of each frame.

It must be remembered that the windows and the frames themselves were manufactured in a factory away from the site of the building and that they were made to template exactness. The secret of having these on a perfect plane and perfectly plumb depended on the accurate setting of a stud bolt in the concrete floors over which the window brackets fitted. It does no good as a matter of accuracy to set such a bolt before the concrete is poured as it will shift its position. Therefore, after the concrete was poured the location of these bolts was laid out with engineering exactness, and once the precise location was established, they were connected to their beam supports in their exact locations by means of a stud welder. With these bracket beams being made so accurately and the bolts being placed so accurately, there was no question of the windows being in a plane plumb and level.

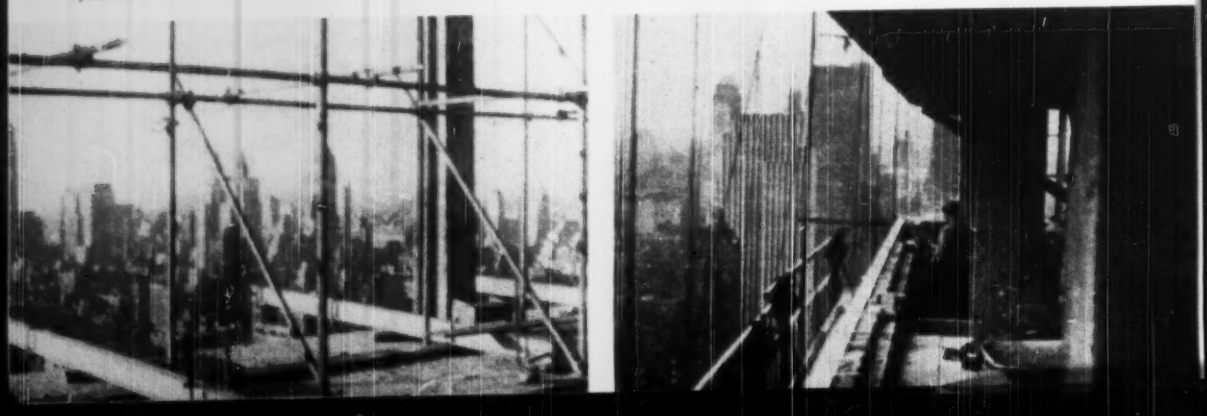
Constant Attention to Safety Measures

Emphasis should be placed on precautionary measures taken to assure the safety of the men. Moving hanging scaffolds such as are made by the Patent Scaffolding Company were extensively used. These were pulled up close to the floors while the various operations were in progress. The men were constantly warned of safety hazards through an organized campaign of instruction to the foremen, and by notices posted about the building. Constant attention and emphasis were given to clean housekeeping in the building and the maintenance of railings around all the shafts. Stairs and passageways were provided with treads and railings as soon as practicable.

I am glad to say that the State of New York has looked over our safety precautions and even taken pictures of them. We have not had any bad accidents on this building although I

(*Continued on page 91*)

MASONS' SCAFFOLDS are supported at work height by light aluminum I-beam sections projecting out from floor slab (below, left). Position of scaffolds (below, right), just below working area and pulled up close to building, imparts feeling of safety to men working close to edges of building and protects those in lower areas from hazard of falling debris. Such scaffolds also serve to speed work of men in hazardous positions.



Engineers' Notebook

Unsymmetrically Loaded Continuous Beam Designed by Graphical Calculus

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CONTINUOUS BEAMS can be solved analytically, graphically or by a combination of the two methods. Which procedure is best depends chiefly on which method was originally taught to the engineer, and which he finds easiest and most suitable.

In most methods it is necessary to find the area and center of gravity of the bending moment diagram. With the loading on each span given, graphical calculus provides an easy means of getting the area and its center of gravity. It also provides the means of getting the complete information for the continuous beam, including reactions at supports, bending moment, slope and deflection for every position along the beam.

TABLE OF NOMENCLATURE

A = line about which shear, V_1, was integrated to give BM_1
A_2 = area of BM_2 diagram, obtained by integrating curve BM_1
B = line about which shear, V_2, was integrated to give BM_2
BM_1 = bending moment of loads on span l_2, with closing line on slope
BM_2 = bending moment of loads on span l_2 to double above scale with closing line level
BM_4 = true bending moment of loads on span l_2 combined with bending from continuous beam to same scale as BM_2
C = line about which M-line was procured from A_2 and Conjugate Points method
D = line about which revised BM_4 curve was drawn and integrated to give slope curve, S, and deflection curve, δ_2
E = line about which true slope is measured and integrated to give δ_2
E = modulus of elasticity = 3×10^7 for steel
F = a location point on line C
F' = the same point when bent around to make M-line straight
G = another locating point on line C
G' = location of point G with M-line straight
I = moment of inertia
M_1, M_2 = bending moments at supports F and G, which are double size because r_2 = $^1/_2$ in.
O, P_1, P_2, Q_2, Q_3, $T_{1\cdot2}$, $T_{2\cdot3}$, U_2, V_2 = points located by Conjugate-Point method
R_1' = reaction at left support due to continuous beam
R_4' = reaction at right support due to continuous beam
R_2'' = reaction at left of center span due to loads on simple center span
R_3'' = reaction at right of center span due to loads on simple center span
R_2' = reaction at left of center span due to loads on center span and continuous beam
R_3' = reaction at right of center span due to loads on center span and continuous beam
S = slope in inches per 1 in. of horizontal length
W_1, W_2, W_3, W_4 = loads on center span
a = R_1' = differential of BM_4 = shear in span l_1
b = uplift at G due to R_1'
c = uplift at F due to R_4'
d = R_4' = differential of BM_4 = shear in span l_3
r_1, r_2, r_3, r_4, r_5, r_6, r_7, and r_8 = radii in inches of the Jacob Integraph with subscripts indicating order of use or a corresponding length from another method of integrating. Values are given on drawing, Fig. 1
δ_2 = deflection of continuous beam, vertically exaggerated, with supports on slope
δ_3 = deflection of continuous beam, vertically exaggerated, with supports on level

A solution by graphical calculus for a three-span continuous beam of uniform section, with the center span loaded symmetrically and the two end spans of the same length without loading, was given by the writer in CIVIL ENGINEERING for February 1949, page 49. The solution here given, also by graphical calculus, is for a three-span beam of constant section, in which each span is of a different length and the center span is loaded unsymmetrically.

The deflection diagram (Fig. 1) gives a picture of the shape of the beam to an enlarged elevation scale. The relationships between loads, reactions, bending moment, slope and deflection are given by the equations:

$$\text{Load on beam, } L = \frac{EI\,d^4y}{dx^4}$$

$$\text{Shear, } V = \frac{EI\,d^3y}{dx^3} = \int L\,dx$$

$$\text{Bending moment, } M = \frac{EI\,d^2y}{dx^2} = \int\int L\,dx^2 = \int V\,dx$$

$$\text{Slope, } S = \frac{EI\,dy}{dx} = \int\int\int L\,dx^3 = \int\int V\,dx^2 = \int M\,dx$$

$$\text{Deflection, } \delta = EI\,y = \int\int\int\int L\,dx^4 = \int\int\int V\,dx^3 = \int\int M\,dx^2 = \int S\,dx$$

These equations show that the successive differentiations are dependent on similar conditions, being in just the reverse order of integration. If E and I are variables, they must be included inside the integration sign. The constants of integration have not been shown in the above equations. Usually they can be taken care of graphically by the physical conditions, such as supports on level, etc.

A very complete graphical treatment of continuous beams was given by L. H. Nishkian and D. B. Steinman, Members ASCE, in ASCE TRANSACTIONS, Vol. 90, June 1927, under the title, "Moments in Restrained and Continuous Beams by the Method of Conjugate Points." The article includes the solution of 17 examples on pages 20 and 21. The numerous discussions of this paper present other ways of solving the problem which add much to the value of the presentation.

Solution of Three-Span Beam

In Fig. 1 is shown the solution of a three-span beam of uniform E and I throughout, a loaded center span, and with all spans of different lengths. This solution is complete except for a definite value of E, I and scales. Graphical calculus was used throughout with only simple arithmetical calculations. The Conjugate Point method was used to determine the moment line.

A complete solution is given by using a 10 I 25.4 section I beam with I = 122.1, V = 24.4, b = 4.66 in. and t = 0.31 in. With a load scale of 1 in. = m lb = 10,000, and a length scale of 1 in. = n = 40 in., the following is true:

Bending moment scale, b, 1 in. = mnr_5 = $10{,}000 \times 40 \times {}^1/_2 = 2 \times 10^5$

Slope scale, S, 1 in. = $mn^2 r_5 r_6$ = $10{,}000 \times 40^2 \times {}^1/_2 \times 1 = 8 \times 10^6$

Deflection scale, δ_5, 1 in. = $mn^3 r_5 r_6 r_7$ = $10{,}000 \times 40^3 \times {}^1/_2 \times 1 \times 1 = 32 \times 10^7$

Maximum BM_2 = 1.46 in. $\times$ 2×10^5 = 292,000 in.-lb., 292,000 ÷ 24.4 = 11,960 psi

Maximum Slope = 1 in. $\times$ $8 \times 10^6 \div EI = 8 \times 10^6 \div (3 \times 10^7 \times 122.1) = 0.00218$ in. per 1-in. length horizontal

Maximum Deflection, δ_2 = $1.05 \times 32 \times 10^7 \div EI = 1.05 \times 32 \times 10^7 \div (3 \times 10^7 \times 122.1) = 0.0917$ in.

Maximum Shear Stress = 1.59 in. $\times$ 10,000 ÷ (10 in. $\times$ 0.31 in.) = 5,130 psi.

The reaction R_1' = 0.24 $\times$ 10,000 = 2,400 lb.

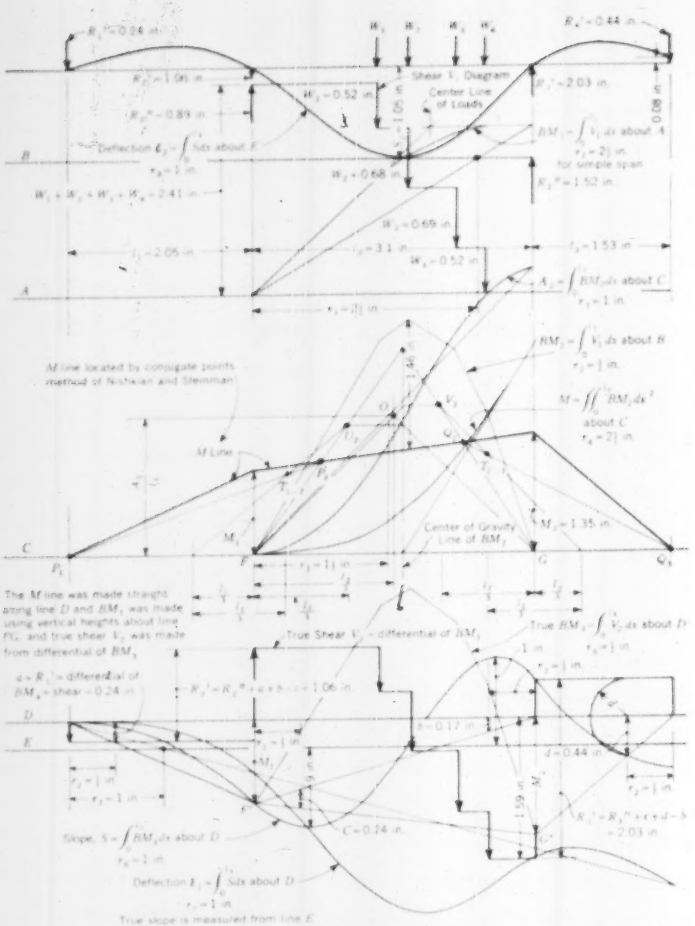
Shear V_1 Diagram
Center Line of Loads
Deflection $\delta_1 = \int_0^1 s\,ds$ about E
$BM_1 = \int V_1\,dx$ about A
$r_1 = 2\frac{1}{2}$ in. for simple span
$BM_2 = \int V_2\,dx$ about B
$A_2 = \int BM_2\,dx$ about C
$M = \iint BM_2\,dx^2$ about C
M Line located by conjugate points method of Nishkian and Steinman
M Line
Center of Gravity Line of BM_2
The M line was made straight along line D and BM_2 was made using vertical heights about line EG, and true shear V_2 was made from differential of BM_2
True Shear V_2 = differential of BM_2
True $BM_2 = \int V_2\,dx$ about D
Slope $S = \int BM_2\,ds$ about D
Deflection $\delta_2 = \int s\,ds$ about D
True slope is measured from line E

FIG. 1. GRAPHICAL CALCULUS solves for bending moments and deflections in continuous three-span beam of constant section, with center span loaded unsymmetrically and unloaded end spans of different lengths.

The other values are m times the length in inches. All values are slide-rule values as taken from the scaled lengths.

Reactions for Simple Span

The reactions for a simple span are obtained by the integration of the shear (V_1) diagram to give BM_1 and line B. They are $R_2'' = 0.89$ in. and $R_3'' = 1.52$ in. Integrating the shear about the line B, just located, gives BM_2 which shows that the line B is correct, as BM_2 starts at F and ends at G on the same elevation. The slope curve is correct in the first span, showing it to be twice as much at R_2' as at R_1' but this is not quite correct for the last span. The deflection curve is almost correct as it is on the same level at R_1', R_2' and R_3' but is 0.08 in. high at R_4' or 0.0917 in. $\times$ 0.08 in. ÷ 1.05 in. = 0.00698 in. above the support R_4' for the beam used.

The r_1 to r_8 are subscripts to indicate the order of use, and each r is the radius on the Jacob Integraph or a corresponding length from another method of integration, used to integrate the different parts.

If slope and deflection were not required, the drawing about lines A, B and C would suffice, and the reactions R_1', R_2', R_3' and R_4' could be computed arithmetically.

It is interesting to consider both old and new methods for arriving at the same results.

Aggradation in Rio Grande Valley Affects Sedimentation of Elephant Butte Reservoir

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ELEPHANT BUTTE Reservoir has special interest in connection with the study of reservoir sedimentation, partly because of the long period of record available and partly because of the singular situation at the lower end of the Rio Grande Valley, which has been undergoing aggradation since before the reservoir was built. The slope of the valley floor at the San Marcial gaging station, located a few miles above the head of the reservoir, has been flattened to such an extent that drainage channels are largely inoperative and the flood menace is greatly increased. In fact, all business houses and residences in San Marcial were long ago abandoned.

Sediment Measured Since 1897

Suspended sediment carried by the Rio Grande has been measured at the San Marcial gaging station since 1897, or 18 years before the Elephant Butte Reservoir was first filled. This sediment is reported in tons but sediment surveys give the totals in acre-feet. One of the important problems is to determine the relationship between sediments accumulated in the reservoir and suspended sediments passing San Marcial.

Under date of February 1949, the U.S. Bureau of Reclamation has issued a report entitled, "Sedimentation Surveys of Elephant Butte Reservoir, Rio Grand Project, New Mexico-Texas," which contains the results of a carefully planned and executed survey as of April 28, 1947. Field work extended from August 28, 1946, to June 6, 1947, although not continuously. The report also includes results of all previous sediment surveys and results for the entire reservoir period, 1915–1947.

Several adjustments must be made in the sediment record as recorded. For one thing, the record does not include all sediments passing the station. A substantial volume of coarser material is rolled along the stream bed, constituting the unmeasured bed load, and also the sampling method used measures only about nine-tenths of the total suspended load. The amount of unmeasured bedload can only be inferred from the accumulated sediments in the reservoir and their specific weight. A summary of basic data, in round numbers, follows:

Suspended sediment passing San Marcial, Jan. 6, 1915, to April 28, 1947 (32.33 years determined by sampling), in tons	545×10^6
Corresponding volume, in acre-ft, at specific weight of	
53 lb per cu ft*	472,200
62.5 lb per cu ft†	400,400
66.5 lb per cu ft‡	375,400
65.0 lb per cu ft§	384,000
Accumulated sediment measured in reservoir in acre-feet as of April 28, 1947	
Total measured	464,600
Sediment and flow in density currents	+ 5,500
	470,100
Estimated contribution below San Marcial	− 23,500
Total acre feet passing San Marcial	446,600

* "Silt in the Rio Grande," W. W. Follett, *Engineering News*, Jan. 1, 1914.

† *Plan for Development, Middle Rio Grande Project*, U.S. Bureau of Reclamation, 1947.

‡ *Flow of Rio Grande and Tributary Contributions*, Water Bulletins Nos. 1–19, 1931–1948, International Boundary Commission.

§ "Future of Lake Mead and Elephant Butte Reservoir," J. C. Stevens, TRANSACTIONS, ASCE, Vol. 111 (1946), p. 1238.

Comparing the suspended sediment passing San Marcial as determined by sampling with the accumulated sediments measured in place by the 1947 survey, if the average specific weight of the accumulated sediments be taken at 53 lb, the bedload becomes negative, since the suspended load passing San Marcial is 5.7 percent more than the accumulation in the reservoir. If, however, the specific weight is taken as 62.5 lb, the unmeasured bedload is 10.3 percent; if 66.5 lb, 15.9 per cent; and if 65 lb, then 14.0 percent of the total measured suspended sediment inflow.

Estimated Sediment Compared with Actual

In his TRANSACTIONS paper (referred to in footnote§ above) the writer added 15 percent (p. 1236) to the measured suspended sediment inflow to correct for bedload. This amount would represent 13 percent of the total sediment inflow. No correction was made for inaccuracies of sampling. The Bureau has since estimated that the recorded suspended load was 0.91 percent of the probable total. Making this correction, the total unmeasured sediments passing San Marcial become 14.3 percent, which may be compared with the 14.0 percent given above for a specific weight of 65 lb.

No one specific weight can be assigned to accumulated sediments in a reservoir since deltaic deposits at the upper end are heavy, and flocculent deposits at the lower end are light. Also as sediments accumulate they become compacted. Samples taken by the Bureau in 1915–1916 indicate that the specific weight varied from about 90 lb per cu ft dry weight in the delta area to half that value just above the dam. The Bureau concludes that the average specific weight of the deposits at the time of the 1947 survey was 65.9 lb per cu ft. (In his TRANSACTIONS paper the writer's average value was given as 65 lb, after the partial survey of 1940.) The Bureau concludes that the ultimate average weight of the deposits in the Elephant Butte Reservoir, presumably when it is filled with sediment, will be between 75 and 83 lb.

Sediment Accumulations Measured in 1947

Besides the total drainage area tributary to the San Marcial gaging station of 24,176 sq miles, 1,747 sq miles are directly tributary to the reservoir between San Marcial and the dam, of which 675 sq miles are in Monticello Canyon and 45 sq miles in Nogal Canyon, in both of which sediment accumulations were measured during the 1947 survey. As a result of these surveys the Bureau concludes that for the period 1915–1947 the contribution from this area was 41.67 acre-ft per year for 100 sq miles of drainage area, or say 0.42 acre-ft per sq mile per year—that is, 600 tons per sq mile per year at the average specific weight of 65 lb. In his paper previously referred to the writer used 1,600 tons. However, the Bureau states:

"It is believed that the estimate, as made, omits some of the delta deposits derived from the canyons and all of the fine sediments which are carried out into the lake beyond the limit lines selected," and, the writer would add, "all wind-blown deposits falling into the lake."

The average of deposited sediments for the entire Rio Grande valley from near Cochiti, 2 miles above the

(*Continued on page 96*)

Allowable Column Loads Show Wide Variation

To the Editor: The writer has recently had occasion to compare various design specifications with regard to eccentrically loaded steel columns. The magnitude of the variation in the designs obtained was somewhat surprising. In a stress condition for which a theoretical analysis is possible, there seems to be no justification for two commonly accepted codes to give allowable loads differing by as much as 71 percent. It is not my purpose to assess the validity of the various codes but merely to call to the attention of the profession a situation that should be corrected.

To illustrate, Fig. 1 (*a*) shows the allowable average stress in an SWF 31-lb column section as given by three different codes.* At a slenderness ratio of 140 the value given by the AASHO Specifications is 50 percent greater than that given by the AISC. At a slenderness ratio of 120, the usual limit for primary members, the AASHO value exceeds the AISC by 31 percent.

The example given is by no means uncommon. Curves of a more general nature constructed by the writer show the same variation irrespective of cross section. This section is very often used for light columns. Bending is about the strong axis and the eccentricity ratio (ec/r_x^2) of 0.6 is in the moderate range—that is, the maximum fiber stress is 1.6 times the average stress. Curves for other eccentricities would show the same tendencies. The moment at the bottom of the column may vary from zero to $P \times e$ in a clockwise direction, as shown, without affecting any of the curves.

Of more importance than the percentage difference in the allowable loads is the fact that the three codes approach the problem in three entirely different ways. This is obvious from the shape of the three curves. The fact that the AASHO allowable load remains constant throughout this range of slenderness ratios, while the AISC load decreases by 40 percent in the same range, represents a considerable difference in theoretical viewpoint. In view of the considerable research and theoretical investigation that have been done on this phase of structural design, this situation seems unwarranted.

The basic design stresses of the AISC Specification are the most liberal. However, its method of handling the eccentrically loaded column is much more conservative. This is reflected in Fig. 1 by the higher AISC stress for very short columns.

As the column section becomes relatively weaker in the plane perpendicular to that of bending, the difference in the allowable loads becomes more pronounced. The curves of Fig. 1 (*b*) are drawn for a 14WF 30-lb section but in other respects are identical to those of Fig. 1 (*a*). At a slenderness ratio of 140, the allowable average stress as given by the AASHO is 71 percent greater than that given by the AISC.

Comparing (*a*) and (*b*) of Fig. 1, it is surprising to observe that, as the ratio r_y/r_x decreases the allowable load as given by the AASHO remains constant, that given by the AISC decreases, and that given by the AREA increases.

The development of the rigid frame has increased the importance of this problem in recent years. It seems reasonable to expect more uniformity in the various design specifications for the case of the eccentrically loaded steel column.

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Cambridge, Mass.

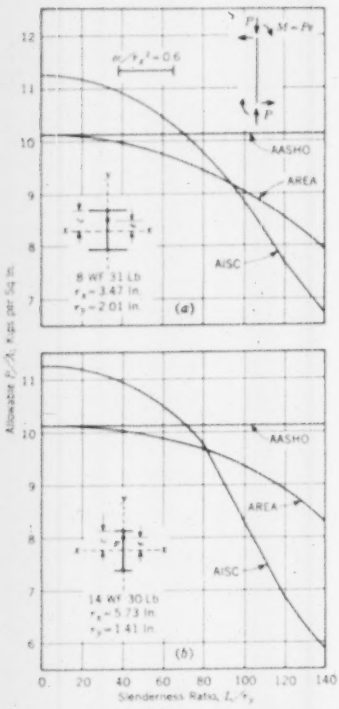


FIG. 1. ALLOWABLE average stresses in steel column sections under eccentric loading vary widely according to three codes—AASHO, AREA, and AISC. Top, (*a*), applies to 8WF 31-lb beam, and bottom, (*b*), to 14 WF 30-lb beam. Both are structural carbon steel with riveted ends

Large But Variant Excess Capacity of Bridges Discussed

To the Editor: The capacity of bridges to carry overload was well illustrated by the article, "Field Test Breaks Prestressed Concrete Girder," page 74 of the December 1949 issue. It is most gratifying to note that because of good materials and workmanship, the girder carried 2½ times the design live load before the first crack appeared, and over ten times the live load before impending collapse.

The writer wishes to emphasize the fact that this case was a typical example of the enormous load-carrying capacity of many bridge parts, not alone of prestressed concrete girders. In fact, had the same conditions existed in an ordinary reinforced concrete bridge girder, the overload capacity would have been even greater. This is due to two reasons: (1) the large safety margin reserved in the allowable stresses in reinforced concrete design, and (2) the high dead-load to live-load ratio for the heavier reinforced concrete bridge.

On the other hand, if the load-carrying strength of the bridge floor is considered, the overload capacity of either the prestressed or the reinforced concrete bridge will be greatly reduced, primarily because of the lighter dead load on the floor system.

It is not my intention to express a preference for one design or the other but rather to call attention to the principle of "balanced design," to show the illogicalness of present-day design methods which lead to widely divergent overload capacities for bridges of different design, as well as for different parts of the same bridge.

T. Y. Lin, Assoc. M. ASCE
Associate Professor of Civil Engineering, University of California
Berkeley, Calif.

* (1) "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings" (1946), American Institute of Steel Construction.
(2) "Specifications for Steel Railway Bridges" (1948), American Railway Engineering Association.
(3) "Standard Specifications for Highway Bridges" (1949), The American Association of State Highway Officials.

"Second-Fiddle" Role of Rail Transport Deplored

TO THE EDITOR: The trend in present planning away from railway and toward highway commuter transport is significantly brought out in the symposium in the December issue on the planning and financing of necessary highway improvements for the environs of our national capital. New York, the largest and one of the oldest of our cities, uses rail transport almost exclusively for its millions of commuters. This fact explains why auto traffic crossing the Hudson River is lighter than similar traffic crossing the Potomac River.

It is the younger cities, now in the process of developing their transport framework, which seem to resort more to the superhighway. This trend away from rail transport shows that the extra convenience of the automobile to the commuter evidently more than balances the advantages of rail transport of commuters; that one track is equivalent to about four highway lanes, with resulting savings in rights-of-way and bridges; that rail transport seldom requires tax support or federal grants; that rail transport allows the family to get along with one less automobile; and that rail transport does not aggravate the parking and traffic problem of the downtown areas into which new superhighways pour their new loads.

Many engineers view this "second-fiddle" role of the railways with sadness—for sentimental if not for economic reasons.

HERBERT A. SAWYER, JR., Jun. ASCE
Assistant Professor of Civil Engineering,
University of Alabama
University, Ala.

Formula for Ring-Girder-Supported Pipe Corrected

TO THE EDITOR: In my article, "Formulas Facilitate Design of Ring-Girder-Supported Pipes," in the September issue, the formula for the moment at the bottom of the ring girder, M_b, should read

$$M_b = M_t + \frac{Qa'}{2} \quad . \quad . \quad . \quad (11)$$

In the formula as it appears on page 56, top of middle column, there is a minus sign instead of a plus sign before the term $Qa'/2$. This error was introduced in the process of getting the article into print.

H. ALDEN FOSTER, M. ASCE
Principal Associate, Parsons Brinckerhoff, Hall & Macdonald
New York, N.Y.

Publication of "Proceedings" as Separates Opposed

TO THE EDITOR: In the December issue of CIVIL ENGINEERING there appeared a brief notice of the Society's intention to replace the present form of PROCEEDINGS with separates of the individual papers which would presumably be available only on order. Since this boded ill for the continued high worth and prestige of our technical publications, I at once wrote in protest, with the request that my letter be published in the January issue. I was informed in due time that the letter arrived too late for publication, and the suggestion was then made that I might wish to reconsider my protest after study of the more detailed information scheduled to appear in the January and February issues. Having now had the opportunity of examining the January announcement, I continue to consider my original protest—although no longer timely—still fully justified.

For at least half a century the strength of the ASCE technical publications has lain in the thorough discussion of each paper which the method of monthly issues has stimulated. While some comments have obviously been worthless, in many instances the net value of the discussions has approached, if not exceeded, that of the papers themselves—not because of a weakness in the papers but because of the added perspective which the experience and constructive criticism of other authorities in the field can provide. If the discussions which are submitted, as well as the papers on which they are based, do not receive wide circulation until their final appearance in TRANSACTIONS, this particular and unique function of PROCEEDINGS will be almost wholly lost—as is well demonstrated by the meager and often trite discussions appearing in contemporary journals which either limit or do not attract sound critical opinion.

I have found from personal experience with other societies operating on the separates basis that (*a*) one seldom orders separates; (*b*) papers available only on order are practically never discussed; and (*c*) increasing the number of papers at the expense of the discussions lowers the over-all quality of the result. If therefore, the Society is faced with the necessity of publishing more papers at less cost, why not adopt a method which will accomplish these ends with minimum sacrifice of those features which the years have proved desirable? Although segregation of papers and discussions into four divisional groups, each of which is published only quarterly and sent only to members of the respective Divisions, is apparently not the cheapest alternative, cheapness is not the ultimate criterion, and this method would appear to involve a minimum sacrifice of present worth. If the weakness of a few discussions plays a role in the issue, surely the divisional editing of the discussions as well as of the papers is more logical than arbitrarily forcing the discussions down to a dangerously small percentage of the publication volume.

Investigation of the records of the Society will show that essentially the same change as is now proposed was first attempted some thirty years ago, but had to be abandoned within less than a year as a result of member protest. While the writer seeks in no way to underestimate the painstaking efforts of the committee which has investigated the publications situation, he wishes to register definite disagreement with their recommendations. And he protests in particular the final action taken by the Board of Direction without giving the membership as a whole the opportunity of voicing an opinion on the details of the plan adopted.

HUNTER ROUSE, M. ASCE
Iowa City, Iowa

EDITOR'S NOTE: Over two years of careful study has been made by a Special Committee and the Board of Direction on this subject. CIVIL ENGINEERING reported five times during 1949 that separates were under consideration. In March 1949 an eight-page progress report by the Special Committee was mailed to each Local Section with the request that Local Sections consider the problem and the progress report and give the Committee the conclusions and recommendations of the Section. All recommendations received were considered by the Committee, and its final report reflected the majority opinion expressed. The proposal to publish PROCEEDINGS papers as separates was fully discussed by an officer of the Society before a meeting of the Iowa Section in Des Moines in April 1949. The Board adopted the final report of the Committee last November 1. The new plan has been launched as directed by the Board at the 1949 Fall Meeting. In a recent letter to Professor Rouse, Past-President R. E. Dougherty stated, "It is only by trial of the plan that the judgment of the Board can be tested. May I not therefore offer the suggestion to you that the plan be given a fair trial before it is condemned?"

SOCIETY NEWS

Ernest E. Howard Inducted as ASCE President

Members Honored and Notable Technical Program Presented at 97th Annual Meeting

THE MAJOR CONTRIBUTION of ASCE to the development of the profession was emphasized by President Ernest E. Howard in a brief talk following his induction into the Society's highest office at the opening session of the 97th annual meeting, held at the Hotel Commodore in New York City, January 18-20. When the Society was founded in 1852, Mr. Howard said, there was very little distinction between the engineer and the skilled craftsman. There was only one engineering college in the entire country, and there were only three with engineering curricula. Until the formation of the other Founder Societies several decades later, he pointed out, ASCE stood alone in attempting to formulate standards for the profession.

Commenting on the approaching ASCE centennial, which will be celebrated in 1952, Mr. Howard drew attention to the fact that at the Society's halfway mark in 1902 its membership was only 10 percent of its present enrollment of more than 27,000, and stated that its growth in the past half century has paralleled the phenomenal development of the profession. He called it "an honor, a privilege, and a challenge to follow in the footsteps of the founders of the Society."

Officers installed in addition to Mr. Howard, were two Vice Presidents and nine Directors. Conferring of honorary membership upon four members, and the award of Society prizes and medals to 12 engineers for their papers in TRANSACTIONS also took place at that session.

Proposed Constitution Discussed

During the Wednesday morning business meeting amendments to the proposed Constitution and pertinent to the petitions for a change in the Constitution as received, were presented by Past President E. M. Hastings and adopted by the meeting. A motion from the floor to return the proposed new Constitution to a committee for further study was declared out of order, but the Chair twice announced that he would entertain a motion to postpone sending the proposed new Constitution to ballot until after the Summer Meeting. No motion to postpone was forthcoming. The proposed new Constitution will now go before the membership for adoption by letter ballot.

Nelson Rockefeller Addresses Annual Luncheon

Stressing the role of the civil engineer in "the development of the country and of our natural resources on a scale never before known," Nelson Rockefeller, president of the International Basic Economy Association, called for increasing participation of the profession in world affairs in the keynote address at the Wednesday luncheon meeting. In a world in which economic forces are increasingly dominant, he said, the profession is being thrown into a position, not only of economic and social importance, but of great international political importance.

ASCE PRESIDENT ERNEST E. HOWARD, internationally known bridge authority and member of Kansas City, Mo., and New York firm of Howard, Needles, Tammen & Bergendoff, has served the Society as Director and Vice-President and in many committee assignments. He was first chairman of the Committee on National Affairs. He has been responsible for the design and construction of bridge and other projects all over the world, and currently is an engineer consultant on general design to the Commission on Renovation of the White House.

Mr. Rockefeller referred to the establishment of international corporations in South America, particularly in Brazil, in which he has played a leading role, and stated that it was an attempt to translate wartime cooperation into peacetime cooperation—"not for defense but for economic development, for rising standards of living, for greater opportunity. Frankly," he said, "we thought that that was the great role for the future of the United States, . . . not only from the point of view of the other people, but realistically and selfishly from our own point of view—that with an expanding world economy we had the opportunity of moving forward to greater heights of achievement and greater standards of living in our own country.

"We thought that man could use, or that we as American people—private enterprise—could use the technical experience, the capital accumulation and the managerial experience of the past hundred and fifty years to help other countries solve their economic and social problems and . . . break bottlenecks in their economy that were holding back the economic development."

Pointing to the fact that American private enterprise, including many civil engineers, has been going abroad for a hundred and fifty years and has "done a magnificent job in the development of raw materials and of productive facilities in other parts of the world," Mr. Rockefeller stressed the fact that we must go a step further today if we are to aid in the development of the world picture, and take to the peoples of the world the technical "know how" of this country—"not because we have an urge to go out and do something, but using it to help them solve their problems on a sound business basis."

In conclusion, Mr. Rockefeller said, "if we are able to create international conditions on a basis of expanding world economic life with a refinement of world order and inter-governmental understanding, then we can get a setting in which you engineers can move into the same position in the world scene that you have had in the domestic scene in the past hundred and fifty years, and do for the other countries of the world or help them do what you have helped this country accomplish . . . . You hold the key to expanding economic development, to rising standards of living, to hope and opportunity for the peoples of the rest of the world. Let's join with them in seeking these common goals."

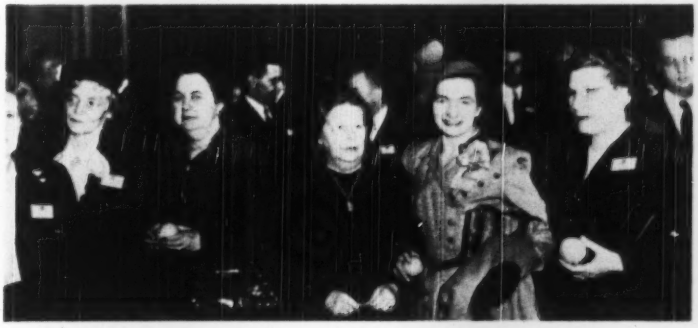
NEW ASCE OFFICERS AND TOP PRIZE WINNER are shown at Wednesday morning meeting. Left to right (in upper left-hand photo) are Albert Haertlein, Vice-President, Zone I; Frank L. Weaver, Director, District 5; Otto Holden, Director, District 3; and Gerard H. Matthes, winner of Norman Medal. Mr. Holden has distinction of being first Board member ever elected from Canada. He is assistant general manager engineering of the Hydro-Electric Power Commission of Ontario, Toronto. In upper right-hand photo new ASCE President Ernest E. Howard chats with Henry Tammen, of New York, (left), and W. N. Downey, Norfolk, Va. Mr. Howard (left in left-hand photo) is congratulated by outgoing President Franklin Thomas following his induction to Society's highest office at Wednesday morning meeting. Seated is outgoing Vice-President J. W. Cunningham, Portland, Ore.

Construction Luncheon on Thursday

ASCE President Ernest E. Howard led off a symposium on creation of a permanent United Nations Headquarters, which featured the Thursday Construction Luncheon, with a talk on the civil engineer's part in attaining the objectives of the United Nations, which is abstracted elsewhere in this issue.

Byron Price, assistant to the Secretary General of the Headquarters Planning Commission, then discussed the problems confronting the United Nations in the early days before the location and character of the permanent headquarters were decided, and described the financial and administrative structure of the organization. In the planning and construction of the headquarters project, he said, there is in microcosm the kind of cooperation needed symbolically in the United Nations itself. Decrying predictions of gloom for the UN situation, Mr. Price called the building of the permanent headquarters, "an act of faith, a sign to the peoples of the world that it will be needed and useful," and stressed the need for that faith in overcoming world animosities and "lighting the way to a better world."

Special engineering and architectural problems confronting the planners of the headquarters were then described by Wallace K. Harrison, director of planning for the project. Mr. Harrison stressed the cooperation that had been obtained in the planning, despite the fact that many different nations and architects were involved. From the outset, he said, there was similarly close cooperation between the architects and the engineers on the many mutual problems arising. After long study going back to Egyptian architecture to get simplicity and uncluttered lines, Mr. Harrison said, the architectural plan of the headquarters was finally decided upon as a "simple workshop for peace."



DISTAFF SIDE IS REPRESENTED at New York Annual Meeting by (left to right) Mrs. Gail Hathaway (only partially visible), Washington, D.C.; Mrs. W. W. Horner, St. Louis; Mrs. Joel D. Justin, Philadelphia; Mrs. Harold Blakeslee, New Haven, Conn.; Mrs. Robert B. Brooks, St. Louis; and Mrs. Wm. N. Carey, New York.

The final paper in the symposium on construction organization and methods, by Lou Crandall, president of Fuller, Turner, Walsh, Slattery, Inc., and George A. Fuller Co., New York, appears elsewhere in this issue.

ASCE-AGC Joint Cooperative Committee Meets

Members of the ASCE-AGC Joint Cooperative Committee, formed a year ago to increase cooperation between civil engineers and contractors, met for luncheon on Friday. Action taken by the group included (1) a decision to disseminate information on men and positions available from the Engineering Societies Personnel Service through AGC chapters; (2) appointment of two members to report on a proposed Department of Transportation in the Cabinet; (3) a resolution to the two societies represented on the Joint Committee to the effect that the two groups consider the failure of state legislatures to supply funds for engineering services to newly created toll bridges and toll highway commissions to be a detriment to the general public, to engineers, and to the construction industry; and (4) information on construction equipment is to be made available to ASCE Student Chapter members in order to give them an opportunity to familiarize themselves with such equipment before graduation.

Technical Divisions Have Extensive Program

To accommodate the large number of technical papers on the agenda, Wednes-

day afternoon and all of Thursday and Friday were devoted to meetings of the Technical Divisions. In all, the ten Divisions meeting scheduled 20 sessions. In addition, the Sanitary Engineering Division joined the American Water Works Association in sponsoring a luncheon and panel discussion. A number of the Annual Meeting papers appear in this issue.

Trips and Social Events

The Construction Division supplemented its two sessions with a tour of the United Nations permanent headquarters project. Other inspection trips and tours took meeting visitors to Lake Success for a glimpse of the United Nations in action; on a tour of Radio City broadcasting studios; and behind the scenes at Grand Central Station. Registration for all trips was so heavy, the lists were closed soon after the meeting got under way.

Social events included an especially gala dinner dance on Wednesday evening, for which Harry Lefcourt and his orchestra furnished the music. The stag smoker, buffet supper, and entertainment for men Thursday evening, which was attended by over a thousand, is believed to be one of the largest single assemblages of civil engineers on record.

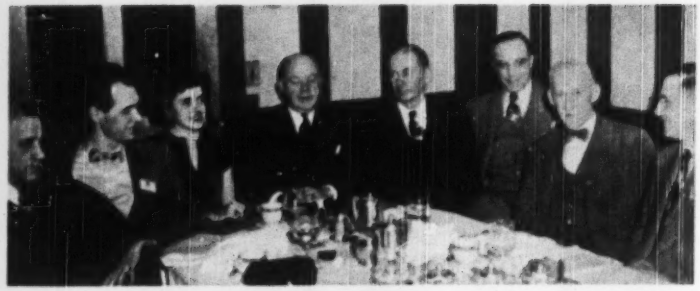
Special entertainment provided for the ladies included a fashion show and tea on Thursday afternoon; an evening sociable, at which Mrs. Dean Edwards, an authority on antiques, spoke on "The Lure of Collecting"; and a tour of the Editorial Workshop of *The Ladies Home Journal*. Mrs. John P. Riley headed the Ladies' Committee on Entertainment.

Metropolitan Student Conference

Seven colleges and schools in the metropolitan area sent more than 200 representatives to a Student Chapter Conference on Wednesday afternoon, which was under the direction of William Koff, chairman of the Metropolitan Conference, and Robert Boesser, chairman of Program Arrangements. President Howard greeted the group briefly, and Robert H. Dodds, member of the ASCE Committee on Student Chapters, discussed activities of the Eastern Chapters. Speakers in a symposium entitled "New Horizons" were Brig. Gen. James H. Stratton, of the Knappen Tippetts Abbett Engineering Co.; Dr. Allan R. Cullimore, president emeritus of Newark College of Engineering; and M. Fornerod, chief engineer of the Preload Corp. Later the presidents of the Metropolitan Chapters reported outstanding activities of their own Chapters in an impromptu and interesting round-table.

Large Registration

The attendance of about 2,000 included a contingent from the Los Angeles Section, which made the trip across the continent especially to extend a cordial invitation to Annual Meeting visitors to attend the Spring Meeting in Los Angeles in April. The hard working committees responsible for the success of the Annual Meeting program were headed by John P. Riley, chairman, and William S. LaLonde, Jr., vice-chairman.



ACTIVITIES OF MUTUAL INTEREST TO ENGINEERS AND CONTRACTORS are discussed at luncheon meeting of AGC-ASCE Joint Committee during Annual Meeting week. Left to right are Carl E. Beam, co-secretary for ASCE; Jim Connelly, visitor from "Construction Methods"; Mary DeMilt, recording secretary; Kirby Smith and Eugene L. Macdonald, representing ASCE; Lester Rogers and Ed Palmer (alternate for Dwight Winkelman), representing AGC, and A. N. Carter, co-secretary for AGC.

Engineers Joint Council Reports 1949 Activities

FOR THE FIRST time since its organization, Engineers Joint Council has compiled a comprehensive annual report. This report was compiled in the office of the 1949 Secretary for EJC, reviewed by the Council's Committee of Secretaries, and received for the record by Engineers Joint Council at its meeting on January 20, 1950. An extract from the beginning of the report follows:

Engineers Joint Council is an evolution from the one-time Joint Conference Committee. The latter, established in October 1941, to promote cooperation among the four Founder Societies, was composed of the Presidents and the Secretaries of the Societies. In 1942 the American Institute of Chemical Engineers became the fifth participating organization. As the scope of activity expanded, stimulated by the urgent need for a united front of the profession during the years of World War II, the Conference concluded that its function was of greater significance than the name implied and, in September 1945, Engineers Joint Council came into being. Thus, although Council had its beginning in 1941, it has just rounded out its fourth full year under its present identity. They have been years of increasingly vigorous and constructive activity. At the year's end the total membership of the five societies of EJC was 111,000.

A major internal step in the development of Council during the past year has been ratification by the governing bodies of the constituent societies of a formal constitution to replace the previous rather informal by-laws. Under its terms, Council now is composed of the two most available recent past-presidents and the secretary of each of the five principal national engineering societies. Previously, the current president of the societies had served with one past-president, with the result that these presidents carried an unduly heavy load during their first year on Council. The new arrangement is a definite improvement.

The officers and members of Engineers Joint Council for 1949 were as listed below: President, R. E. Dougherty; vice-president, Scott Turner; secretary, W. N. Carey; and treasurer, E. L. Chandler.

American Society of Civil Engineers: R. E. Dougherty, Past-President; E. M. Hastings, Past-President; W. N. Carey, Executive Secretary; and C. S. Proctor, alternate.

The American Society of Mechanical Engineers: E. G. Bailey, past-president; E. W. O'Brien, past-president; C. E. Davies, secretary; and R. M. Gates, alternate.

American Institute of Mining & Metallurgical Engineers: H. G. Moulton, past-president; Scott Turner, past-president; E. H. Robie, secretary; and J. L. Head, alternate.

American Institute of Electrical Engineers: J. E. Housley, past-president; D. B. Hull, past-president; H. H. Henline, secretary; and J. F. Fairman, alternate.

American Institute of Chemical Engineers: S. D. Kirkpatrick, past-president; L. W. Bass, past-president; S. L. Tyler, secretary; and D. B. Keyes, alternate.

In former years meetings were held at irregular intervals, depending upon the amount and importance of work confronting Council. Because of the volume of matters requiring attention, and better to systematize procedure, it became increasingly evident that a regular schedule for meetings should be established. Consequently, the third Fridays of odd months now are official dates for EJC meetings. Meetings custom-

arily are held in the Engineering Societies Building in New York City.

The Constitution (Article I, Section 2) states that the objectives of the Council shall be:

(*a*) To advance the general welfare of mankind through the available resources and creative ability of the engineering profession.

(*b*) To promote cooperation among the various branches of the engineering profession.

(*c*) To develop sound public policies respecting national and international affairs, wherein the engineering profession can be helpful through the services of the members of the engineering profession.

Upon that foundation, Engineers Joint Council, in its role as the cooperative, federating agency for the national societies representing the five basic branches of the profession, has been active in a wide variety of matters of national and international scope. Criteria for determining to participate in any such matter are: (1) that it shall be of wide interest to the profession, and (2) that it shall be a matter having a direct impact on the profession or one regarding which it is believed that action by the profession can contribute to the public interest.

For years, EJC has been devoting study to stimulation of greater solidarity of the engineering profession. One of the most significant steps taken during 1949 was the calling of a conference, under the general auspices of council's Committee on Unity of the Engineering Profession, for the purpose of developing specific recommendations as to measures for achieving further unity. Sixteen of the principal national engineering societies were invited to participate. At the meeting, on October 20, 1949, fourteen Societies were represented, delegates of the other two being unavoidably absent. As the result of general discussion, a committee was appointed to study the relative advantages of several suggested courses of action and to report back to the conference at a meeting to be held early in 1950.

EJC Committees Whose Activities for the Year Are Described in the Annual Report for 1949

- Constitution and By-Laws
- General Survey
- Increased Unity in the Engineering Profession
- Labor Legislation
- Science Legislation
- Engineers Cooperating in Medical Research
- Engineers in Civil Service
- Selective Service
- Federal Income Tax
- National Water Policy
- Fuel Resources
- National Engineers Committee
- International Relations
- UNESCO
- Consultative Status with the United Nations

The small expense incurred in connection with the work of EJC is significant. Each year a budget is established and the necessary funds are pro rated among the constituent societies in proportion to dues collections by each for the preceding fiscal year. While expenditures may vary within rather wide limits, depending on the character of projects undertaken, it is interesting to note that for 1948 and 1949, the total each year was $3,900, in round numbers.

Disbursements for 1949 were broken down as follows:

General operating expense and secretarial service	$2,498.28
General Survey Committee	697.23
Committee on Collective Bargaining	250.00
Labor Legislation Panel	376.49
Science Legislation Panel	73.52
Committee on International Relations	33.88
Total	$3,929.40

That so much can be done with so little financial outlay, is a tribute to the large number of men who have contributed vastly of their time and abilities in carrying out the programs of Council. In succeeding pages, there will be found lists of the personnel of major committees. [See EJC report for 1949—Editor.] Review of these will indicate the number and caliber of men who are devoting themselves unselfishly to the objectives of the Council and thus rendering service to their profession, to their country, and to the world. The full extent of that service cannot be appreciated except by those who have been closely in contact with the work.

The list of committees shown in the box on this page indicates the scope of EJC Committee activity. An outline of the objectives and accomplishments of these committees is found in the EJC Annual Report. A copy of the complete report may be had on request from the secretary of any one of the five Engineers Joint Council societies, or from the secretary of EJC for 1950, E. H. Robie, Secretary of the American Institute of Mining & Metallurgical Engineers, 33 West 39th Street, New York 18, N. Y.

E. H. Connor, Hon. M. and Past Director Dies

EDWARD H. CONNOR, Honorary Member of the Society and a bridge authority, died at his home at Leavenworth, Kans., on December 28, at the age of 85. A

Edward H. Connor, 1864–1949

graduate of Washington University, Mr. Connor spent much of his career with the Missouri Valley Bridge & Iron Co., which he joined as assistant engineer in 1899. From 1904 to 1937 he was vice-president and chief engineer, and from 1937 until his retirement in 1946 he served the organization as consulting engineer. He was instrumental in the design and construction of bridges over the Mississippi at Memphis, Tenn.; Rock Island, Ill.; and New Orleans, and served in an advisory capacity with Bridge Builders, Inc., which erected the San Francisco-Oakland Bay Bridge. He had made many designs and improvements in pneumatic caissons.

Long active in ASCE affairs, Mr. Connor was fourteenth on the list of veteran members, having joined as a Junior in 1890. He became a full member in 1900, and was elected to honorary membership in 1943. He served as Director from 1913 to 1915. Mr. Connor was an honorary member of the St. Louis Engineers Club, and a member of the American Railway Engineers Association and of the Chicago Engineers Club.

Membership Listing Is Made Available by Society

AN ASCE MEMBERSHIP listing, geographical as well as alphabetical, is now in the mails as Part II of PROCEEDINGS (the last number of PROCEEDINGS to be issued in bound form). Later an official register, including a directory of Society affairs, Division and committee personnel, and information on Local Sections and Student Chapters, will be distributed. The current membership listing is the first since 1947.

The total membership (almost 27,000 when the listing closed on October 1, 1949) is worthy of comment. Significant, too, is the direction of growth. For the first time, the yearbook shows the grade of Junior preponderant. The Associate Member grade, which was previously highest, now includes fewer than 9,600, while the Juniors exceed that number.

Plan for Publishing "Proceedings" as Separates Gets Under Way

THE NEW PROCEDURE for publishing and distributing PROCEEDINGS papers, adopted by the Board of Direction at its 1949 Fall Meeting, has been launched. The January issue of CIVIL ENGINEERING published abstracts of the first five PROCEEDINGS "Separates" that will be available (page 68); carried an order blank with instructions for obtaining the separate papers (page 107); and abstracted parts of the report of the Special Committee on Technical Publications, Procedures and Costs (page 66). As soon as orders now being received give an indication of the number that must be printed these orders will be filled. Additional data developed by the Committee for the consideration of the Board are recorded here; and abstracts of five additional separates with order blank for securing them appear elsewhere in this issue.

During the progress of its two-year study of all phases of the problem of giving members the quality and quantity of technical papers they desire but by a less costly method than at present, the Board's special Committee in March 1949 mailed to each Local Section an eight-page report on the problem, with the request that after the report and the problem had received local consideration, the Local Sections' recommendations and conclusions be given to the Committee. All recommendations received were considered by the Committee. Its final report reflects the majority opinion expressed.

On April 6, 1949 the Committee presented to the Board "statistics relative to the number of papers published and subjects covered." For the six years, 1943-1948 inclusive, Table I of the final report here reproduced, indicates that an annual average of papers presented to the Publications Committee was 88, while the average number of papers accepted during the same period was 46, and the number of papers published was 38. From this it seemed evident to the Committee that "technical publication progress has not kept pace with the number of papers accepted, to say nothing of the numbers tendered,"—a situation that has long been critical and offers no prospect of betterment under present technical publications procedures.

"Not only is the number of papers published 'important,' the Committee reported, 'but the technical fields covered are of equal moment.'" The distribution of all papers published during the past ten years according to Technical Divisions, is shown in Table II of the report, repeated here.

TABLE I. PROCEEDINGS PAPERS PUBLISHED

Six-Year Averages, 1943–1948, Inclusive

(a) Papers presented to Publications Committee annually—six year average, 88 per year; average for last two years, 124 per year.

(b) Papers accepted for publication annually—six year average 46 per year; 1947, 86 papers; 1948, 38 papers.

(c) Papers published annually—six year average, 38 per year; 1948, 38 papers.

(d) Papers in hands of publication staff (99) as of September 1, 1948, which were in following stages of progress:

1.	Accepted but not edited	26
2.	Partly edited and returned to author for revision	14
3.	Edited and ready for publication	28 — 28
4.	Received and awaiting action by Committee on Publications	31
	Total	99

TABLE II. DISTRIBUTION OF 422 PROCEEDINGS PAPERS PUBLISHED OVER 10-YEAR PERIOD, ACCORDING TO TECHNICAL DIVISIONS

DIVISION	NO. PAPERS PUBLISHED	NO. MEMBERS ENROLLED AS OF JAN. 1, 1949
Air Transport	2*	1,319
City Planning	12	2,427
Construction	37	9,312
Engineering Economics	15	2,167
Highway	19	3,296
Hydraulics	40	3,712
Irrigation	41	1,191
Power	34	1,320
Sanitary Engineering	28	2,749
Soil Mechanics	42	3,853
Structural	115	6,636
Surveying & Mapping	9	2,029
Waterways	28	1,061
Total	422	

* Three-year period only.

After analysis of the categories, or four group, plan the Committee was convinced that "it would be impracticable to work out any grouping of papers to satisfy all members of the thirteen Technical Divisions." For this reason, and because "this plan as compared with the present is less favorable" than the more flexible method of "Separates" the latter method was decided upon. Comparative estimates of the first year's costs for printing and distributing 100 PROCEEDINGS papers as (1) Separates, (2) according to categories, and (3) by the current method, printed as Table III on page 67 of January CIVIL ENGINEERING, showed the economy of "Separates."

Having rejected the Four Group (categories) plan as "unduly restrictive," the special Committee detailed cost estimates of the printing and mailing of the "Separates" plan based on the assumptions shown in the tabulations, reproduced here as Table IV and Table VI of the report.

TABLE IV. ASSUMPTIONS FOR COST ESTIMATES ON SEPARATES

(a) That first printing and distribution of accepted PROCEEDINGS papers would be by Separates.

(b) That papers would average 20 printed pages.

(c) That completed discussions would average 10 printed pages.

(d) That 100 papers and their respective completed discussions would be printed annually.

(e) That 1,000 copies of each paper, in Separates, would be printed and mailed annually.

(f) That 500 copies of each completed discussion of a paper would be printed and mailed annually.

(g) That papers or discussions would be mailed only on request, through a coupon system carried monthly in CIVIL ENGINEERING.

(h) That CIVIL ENGINEERING would carry each month a numbered brief outline of the then current group of papers to be printed.

(i) That TRANSACTIONS in two or more volumes per year would be made available, as under the present plan, except at an increased annual selling price because of the increased number of volumes. The cost of printing and distributing TRANSACTIONS is not included in, nor is it directly relevant to, the PROCEEDINGS problem.

(j) That the mailing of PROCEEDINGS Separates, and all accounting in connection therewith, would be done at the headquarters office of the Society.

Anticipating the addition of a typist to the present Society staff of eight engaged on technical publications, the Committee estimated the staff payroll at about $30,000, which when added to the total from Table VI makes the cost of the "Separates" plan $88,700 for 100 papers per year. The transition from the present 38 PROCEEDINGS papers to 100 will take time, certainly more than a year. However, if during 1950, 60 papers could be published, as the Committee believed possible, the estimated cost would be $66,930, as shown in detail in Table VIII.

TABLE VI. COST ESTIMATES FOR 100 PAPERS PER YEAR SUMMARIZED FROM TABLE V

Paper	$ 750.00
Composition	40,500.00
Printing	3,000.00
CIVIL ENGINEERING Coverage	780.00
Mailing and Addressing Labor	6,000.00
Postage and Envelopes	3,000.00
Plant and Equipment	1,400.00
Division Expenses	3,300.00
Total	$58,730.00

TABLE VIII. ESTIMATE OF 1950 COST OF SEPARATES—60 PAPERS

Paper	$ 500.00
Composition	24,330.00
Printing	2,000.00
CIVIL ENGINEERING Coverage	500.00
Division Expense	2,800.00
Mailing and Addressing Labor	5,000.00
Postage and Envelopes	1,800.00
	$36,930.00
Headquarters Office Payroll	30,000.00
Total	66,930.00
Current 1949 Budget for PROCEEDINGS	$74,060.00

This is within the 1949 budget for PROCEEDINGS. Costs of TRANSACTIONS are not included in this résumé of the Committee's report, since no change in TRANSACTIONS is contemplated.

Advantages of the "Separates" method, as they appeared to the Board of Direction are the probability that papers can be published within six months of their presentation to the Publications Committee instead of two years or more as at present; that a greater number of papers will be made available; and the possibility of preprinting papers in advance of the presentation of PROCEEDINGS papers at meetings of the Society.

It is an integral part of the new publication plan to print and make available discussions of papers with the author's closure as a Separate. Discussion separates are to be available on order and without cost to members ordering the original paper. Members may order individual papers, or if they prefer, may place standing orders for all "Separates," including discussions, at the rate of $3 a year.

Los Angeles Section Prepares Outstanding ASCE Spring Meeting Program

ENGINEERS AND THEIR families going to Los Angeles for the ASCE Spring Meeting, to be held jointly with the Third California Conference of Local Sections, April 26-29, are assured an exceptional program of technical papers, field trips, and entertainment. All but one or two of the Society's thirteen Technical Divisions are arranging meetings, and a special general session will be devoted to a symposium on the Terminal Island subsidence problem. An opportunity to see Terminal Island will be afforded by an all-day trip on Saturday, which will include inspection of the Naval installations there and lunch at the Naval officers' club.

To accommodate the unusually full program, a special opening dinner featuring a speaker of national importance has been arranged for Tuesday evening, April 25, so early registration is advisable. The traditional dinner dance will be held Wednesday evening, and a stag smoker and entertainment for the men on Thursday evening. Friday evening the entire group will go to the famous Knott's Berry Farm for square dancing and other jollity.

Special Entertainment for Ladies

Under the chairmanship of Mrs. Ray L. Derby, the ladies of the Los Angeles Section are arranging an interesting program of entertainment for the visiting women. Wednesday will be devoted to sightseeing in and around Los Angeles, and Thursday has been designated Pasadena Day. In Pasadena the group will have lunch and see a fashion show at Bullock's new store, which has been termed one of the outstanding department stores and specialty shops in the country. That evening the ladies will dine in Pasadena and attend a theatrical performance in the Community Playhouse while the engineers are having their stag smoker. As a result of special arrangements, the group will have the privilege of touring beautiful gardens in the suburb of Bel Air on Friday. This will be an all-day trip, with a luncheon at noon.

The ladies are urged to bring comfortable walking shoes, so they can fully enjoy the sightseeing. Light warm sport clothing and an evening wrap will also be needed as cool days and nights are not unusual in Los Angeles in the spring.

Student Chapter Conference

Nine engineering colleges in California, Nevada, and Arizona, annually meeting during the California Conference of Local Sections, will be represented at a Student Chapter Conference. A special feature of the program will be the presentation of papers, winnowed out in preliminary Student Chapter contests, in the annual student paper competition for Conference prizes. An all-day program of student inspection trips has been arranged for Saturday. Points of interest visited will include Morris Dam and the La Vérne Water Softening Plant of the Metropolitan Water District of Southern California.

Meeting Program in March Issue

A full program of papers, inspection trips, and social events will be printed in the March issue. Ray L. Derby is general chairman of the meeting program, and Trent Dames is in charge of the technical program. Meeting headquarters will be the Ambassador Hotel.

INVITATION TO ASCE SPRING MEETING in Los Angeles is presented to President Ernest E. Howard and retiring President Franklin Thomas by Mr. and Mrs. Ray Derby, Los Angeles, who head General Committee and Ladies' Committee for Los Angeles meeting.

Metropolitan Juniors Sponsor Refresher Course

AS A SERVICE to young engineers in the Metropolitan area, the Junior Branch of the Metropolitan Section is offering a series of weekly refresher lectures in preparation for Part III of the New York State Professional Engineer license examination scheduled for Wednesday, May 17, 1950. The course began on January 10 and will continue for 18 weeks. It is available to young engineers even outside the Metropolitan area.

The instructors, drawn from the civil engineering departments of several universities in the Metropolitan area, will prepare and distribute notes and other review material in their various specialties. Subjects covered include: surveying and layout problems, engineering economics and practice, structures and concrete, hydraulics, sanitary and soil engineering and review.

PROCEEDINGS PAPERS
AVAILABLE AS SEPARATES

THE FOLLOWING PAPERS, to be printed as Separates, are now subject to advance orders, based on the summaries here given. Discussion of these papers will be received as in the past. A summary of each paper will appear in three consecutive issues of CIVIL ENGINEERING, and papers will be mailed soon after returns give an indication of the number to be printed. Abstracts of other papers will be added every month to the list of Separates available. Information concerning distribution to members is noted on the mail order coupon (p. 105).

1. Improvements at the Back River Sewage Works, Baltimore, Md., by C. E. Keefer, M. ASCE. Both increase of load and decrease of relative efficiency combined to require expenditures of almost $4,000,000 in improving primary and secondary treatment for the city and its environs. Included in the improvements were screens, grit chambers, settling tanks, activated sludge units, chlorination, digestion tanks, gas holder and vacuum filters. Other accessories, as pumps, pipelines, and power station, helped in this modernization completed in 1947.

2. Public Utility Condemnation Cases in the State of Washington by Henry L. Gray, M. ASCE. This simple narration deals with the Washington Public Utility Act and its workings, and particularly the acquisition of a number of privately owned light and power properties through 19 condemnation proceedings, all heard in Courts. Many important data are given, also certain conclusions as to what might be expected to happen in such cases, with suggestions and advice as to engineering procedure in condemnation matters.

3. Treatment of Foundations of Large Dams by Grouting Methods by A. W. Simonds, M. ASCE, Fred H. Lippold, M. ASCE, and R. E. Krim, Assoc. M. ASCE. Nowadays large dams require foundation treatment, the success of which is only determined after the structure is in operation. General plans for the successful treatment by pressure grouting as developed in a score of structures completed since 1935 by the Bureau of Reclamation and the TVA, include low-, intermediate-, and high-pressure grouting in specific areas beneath the base. Various grouting materials, methods, and types of equipment are discussed, their advantages and disadvantages being shown under varying conditions and at different locations.

4. Capillary Phenomena in Cohesionless Soils by T. William Lambe, Jun. ASCE. Fundamentals of capillarity in cohesionless soils are explained by first describing analogies in capillary tubes and then presenting data from soil tests to substantiate the conclusions. Presently used theoretical methods for computing the rate of flow of water under the influence of capillarity are investigated and evaluated; and improvements are suggested. The paper also discusses the limiting values of capillary head which a cohesionless soil may have; and the role of the different capillary heads in the various types of capillary flow.

5. Elastic Restraint Equations for Semi-Rigid Connections by J. E. Lothers, M. ASCE. Most beam-column connections, through the outstanding legs of structural shapes, are styled "semi-rigid framing." Deflection of these legs gives rise to a rigidity intermediate between those of simple and "rigid frame" connections. Recent laboratory measurements in this country and England have disclosed a constant, Z, which is needed for the analysis of such connections. Equations here derived for finding Z for the web-angle type obviate the necessity for expensive laboratory measurements.

6. Slope Deflection Equations for Curved Members by Keith T. Fowler, Jun. ASCE. Complex structural frameworks, particularly when under multiple loading conditions, are shown susceptible to simple solutions with few unknowns. "Curved members" include those with a variable moment of inertia. The theory is based on the neutral point concept of the column analogy, and discusses the values added to or subtracted from the fixed-end reactions by changes in the relative positive of the supports. No restriction is placed on the applied loads or joint deflections (including rotations) as long as they lie in the plane of the structure. Three examples, with detailed calculations, illustrate the method.

7. The Geochemistry of Earthwork by Hyde Forbes, M. ASCE. Geologic and chemical processes account for the kinds and quantities of mineral substances found in earth that has been "worked" in the presence of air and water—for example, those set up in the compaction of earth structures and over earth surfaces in excavation. Natural processes active in the weathering of rock and soil development continue and accelerate the production of secondary units of geochemistry. The most obvious physical change produces fine particles and colloidal material from the constituent crystalloid minerals, as determined by the specific gravities of the mineral particles before and after being "worked."

8. Floating Tunnel for Long Water Crossings" by Charles E. Andrew, M. ASCE. A novel and unusual type of floating tube is proposed, to cross Puget Sound from Seattle to the west shore, approximately 14,800 ft. Water depths of between 750 and 800 ft for 10,000 ft preclude any structure on piers. At the center a 50-ft draft clearance is provided between ventilating towers 3,500 ft apart. This four-lane tunnel, involving a self-liquidating bond issue of $60,000,000, will reduce the present ferry cost to less than one-half. An alternate proposal involves floating and suspension bridges at an adjacent site.

9. Atchafalaya River Diversion and its Effect on the Mississippi River by Leo M. Odom, M. ASCE. These new data and concepts concern one of the greatest river problems of all time. In a century the Atchafalaya has grown from a small bayou to a river discharging 640,000 cfs (1945 flood), to the alarm of many able engineers. More recently its increase has been aided by the Mississippi River Commission as part of the over-all flood control project. Many contentions of opponents to its growth have been unanswered, but this paper apparently refutes the claim that increase in the diversion would cause the Mississippi to lose capacity below that point.

10. Pollution Abatement Policy by Thomas R. Camp, M. ASCE. Since the objective of pollution abatement is to reclaim watercourses for appropriate uses, control agencies should aim toward maintenance of adequate water quality at least cost rather than wholesale construction of treatment works. They should permit selection of wastes to be treated for greatest overall economy and provide for assessment of costs in proportion to the amount of wastes produced, whether treated or not. Agencies should establish limiting pollution loads allowable at each point of pollution and should re-allocate loads when other riparian owners wish to produce liquid wastes.

Order coupon on page 105.

Papers and Manuals Available in Reprint

STOCK SUPPLIES OF ASCE papers and manuals have just been replenished to meet the considerable demand for pamphlet copies of the Society's technical material. TRANSACTIONS papers are issued individually and bound in paper covers, similar in general to the form of the Manuals of Engineering Practice. For such individual distribution a stock is maintained at headquarters. The new issues and the base prices are as follows:

Manual No. 8—Engineering and Contracting Procedure for Foundations	$ .70
Manual No. 13—Filtering Materials for Sewage Treatment Plants	1.00
Manual No. 16—Land Subdivision	1.60
Manual No. 22—Soil Mechanics Nomenclature	.70
Paper No. 1568—Design of Symmetrical Concrete Arches by Charles S. Whitney	3.60
Paper No. 1829—Design of Large Pipe Lines by Herman Schorer	2.20
Paper No. 1980—Selection of Materials for Rolled-Fill Earth Dams by Charles H. Lee	1.50

Paper No. 2095—Wind Bracing in Steel Buildings, Final Report of Sub-Committee No. 31, Committee on Steel of the Structural Division 60

Paper No. 2202—Numerical Procedure for Computing Deflections, Moments, and Buckling Loads by N. M. Newmark 1.50

Paper No. 2213—Application of Soil Mechanics in Designing Building Foundations by A. Casagrande and R. E. Fadum 2.50

A 50 percent discount on the foregoing prices is allowed to all members of the Society and to members of Student Chapters.

Send requests to ASCE headquarters.

Appointments Made to ASCE Technical Division Executive Committees

Walter Johannessen
Air Transport

H. W. Alexander
City Planning

Charles H. Tompkins
Construction

Charles M. Noble
Engineering Economics

De Witt C. Greer
Highway

W. E. Blomgren
Irrigation

Byron O. McCoy
Power

Francis S. Friel
Sanitary Engineering

R. N. Bergendoff
Structural

Hibbert M. Hill
Soil Mechanics & Foundations

Henry B. Aikin
Surveying & Mapping

Thomas M. Robins
Waterways

Tellers Report on Final Ballot for 1950 Officers

January 11, 1950

To the Ninety-Seventh Annual Meeting
American Society of Civil Engineers:

The Tellers appointed to canvass the Ballot for Officers of the Society for 1950 report as follows:

For President:

Ernest Emmanuel Howard	8,260
Scattering	7
Blank	23

For Vice-Presidents:

Zone I

Albert Haertlein	8,217
Scattering	7
Blank	66

Zone IV:

Fred C. Scobey	8,246
Scattering	3
Blank	41

For Directors:

District 3

Otto Holden	8,231
Scattering	2
Blank	57

District 5

Frank Lloyd Weaver	8,236
Scattering	2
Blank	52

District 7

Gordon Hubert Butler	8,238
Scattering	3
Blank	49

District 8

Louis Richard Howson	8,238
Scattering	1
Blank	51

District 9

G. Brooks Earnest	8,237
Scattering	1
Blank	52

District 12

Walter Jackman Ryan	8,234
Scattering	1
Blank	55

District 16

George William Lamb	8,234
Scattering	4
Blank	52
Ballots canvassed	8,290
Ballots withheld from canvass without signature	131
Total number of ballots received	8,421

Respectfully submitted,

EDWARD N. WHITNEY, *Chairman*
M. KOFMAN, *Vice-Chairman*

Charles C. Bonin — Thomas R. Kuesel
George S. Bingham — Jarry A. Lenecek
Robert F. Heins — John H. Stamataky
(Tellers)

HORACE A. VANDERBEEK, CHAIRMAN OF LADIES ENTERTAINMENT COMMITTEE for Annual Meeting is photographed with group of members of Ladies' Committee. Seated, left to right, are Mrs. William S. LaLonde, Jr., vice-chairman of Ladies' Committee; Mrs. John P. Riley, chairman; Mrs. Walter S. Douglas, Mrs. Don P. Reynolds, and Mrs. Alfred Hedeline. Standing, in same order, are Mrs. John Zehner, Mrs. William J. Shea, Mrs. Eugene M. Itjen, Mrs. J. M. Garrelts, Mrs. Horace A. Vanderbeek, Mrs. Ford Bartlett, Mrs. Waldo Bowman, and Mrs. Maurice N. Quade. Absent when photo was taken were Mrs. Edward J. Cleary, Mrs. Raymond L. Brandes, Mrs. John M. Buckley, Mrs. Wm. N. Carey, Mrs. E. L. Chandler, Mrs. Morris Goodkind, Mrs. Wm. McK. Griffin, Mrs. C. B. Molineaux, Mrs. Arthur E. Poole, Mrs. Carlton Proctor, Mrs. Kirby Smith, Mrs. Samuel D. Stickle, Mrs. H. C. Tammen, Mrs. Charles E. Trout, and Mrs. Edward Wininger.

FROM THE NATION'S *Capital*

JOSEPH EHLERS, M.ASCE
Field Representative, ASCE

THE SECOND SESSION of the 81st Congress commenced its activities on January 3, 1950. It does not appear likely that there will be any radical departure from the actions of the first session; nor does it appear likely that the session will extend throughout the summer as did the first session.

National Science Foundation Legislation Urged

On January 4, the President delivered his message on the state of the Union. In that speech he again urged the passage of the legislation relating to a National Science Foundation. In this connection it will be recalled that the science bill was held up in the House Rules Committee. Further efforts will be made to bring it before the House.

In his message, the President also referred to the development of our national resources with special emphasis on water policy. On the opening day of the session, the President established a temporary Water Resources Policy Commission of seven members under the chairmanship of Morris L. Cooke. This commission is to study and make recommendations to the President on Federal legislation and policies in the water resources field. The personnel and purposes of this commission are recorded elsewhere in this issue. The matter of water resources policy has received the earnest consideration of committees of both the ASCE and Engineers Joint Council during the past year. The EJC committee has studied various approaches to the problem and has considered it in consultation with such groups as the National Water Conservation Conference, the American Water Works Association, and the National Research Council. All groups concerned will continue their efforts toward the development of some soufid basic water policies for the nation.

Government Reorganization Progresses Slowly

Separate from this matter but at least indirectly related to it is the proposal made in the Hoover Report and elsewhere for an impartial Board of Engineering Review to pass on specific projects and programs. The formation of committees or boards on both policies and projects has been under consideration in the Bureau of the Budget for many months. The Society has taken no action on the Hoover Report for there are conflicting views among members in regard to certain important recommendations. Action on certain recommendations may be expected to prevent the engineering profession being left out of consideration.

The Citizens Committee for the Hoover Report held a national reorganization conference in Washington December 12 and 13, at which time it discussed national resources and engineering projects connected with their development.

During the final days of the first session of the 81st Congress several reorganization proposals made by the President were put into effect. In this column for September 1949, the reorganization plan involving the transfer of the Bureau of Public Roads to the Commerce Department was referred to. The change seems to have had little effect on the operations of this agency.

Another reorganization plan that went into effect at that time involved the Civil Service Commission. Under it the President of the Commission was designated "Chairman" and was given considerably increased power in administering the internal operations of the Commission. This change seems to have speeded up the examining work somewhat but leaves many other problems unsolved. It by no means satisfies the supporters of the Hoover Report for a complete revamping of the system. ASCE has recognized that the relations of the Civil Service Commission to the engineering profession have never been close enough to serve the best interests of the Commission or the profession.

Building Research Advisory Board Meets

In January the newly formed Building Research Advisory Board held its first technical conference in Washington dealing with the relation of weather to building design. The conference was an attempt to acquaint the architects and engineers on the one hand and the climatologists on the other hand with each other's problems in order to obtain information for the improved design of buildings. The conference is reported elsewhere in this issue. ASCE has participated actively in the formation and direction of this Advisory Board, which operates within the National Research Council.

The Housing and Home Finance Agency has established a building research division, under the provisions of the National Housing Act of 1949. Dr. Richard Ratcliff, of the University of Wisconsin, has been named director to head up the research work.

Washington, D.C.
January 21, 1950

NEWS OF LOCAL SECTIONS

Coming Events

Central Ohio—Meeting in the Franklin County Engineer's Office, Columbus, February 16, at 6:15 p.m.

Cleveland—Dinner meeting at the Cleveland Engineering Society, Cleveland, February 17; dinner at 6:30 p.m. and meeting at 8:00 p.m.

Colorado—Dinner meeting the second Monday of every month at 6:30 p.m.; technical meeting at 8 p.m. Section luncheon every Wednesday at Daniels & Fishers Department Store at 12 noon. The Soil Mechanics and Foundations, Hydraulics, Structural, and Irrigation Divisions of the Section meet monthly on the first Monday, the first Tuesday, the third Thursday, and the fourth Monday, respectively.

Kansas—Meeting in Topeka on February 17.

Los Angeles—A seminar with ASCE, ASME, and AIEE participating is to be held at the California Institute of Technology, Pasadena, February 15. The Sanitary Group of the Section is scheduling a meeting for the Clark Hotel, Los Angeles, February 22.

Metropolitan—Meeting in the Engineering Societies Building, New York City, February 15, at 8 p.m.

Philadelphia—Meeting in the Engineers' Club, Philadelphia, February 14, at 7:30 p.m.; preceded by dinner at 6 p.m.

Sacramento—Regular luncheon meetings every Tuesday at the Elks Club, Sacramento, at 12:30 p.m.

San Francisco—Weekly luncheons every Wednesday at the Engineers Club of San Francisco.

Virginia—Meeting at the Hotel Jefferson, Richmond, February 10, at 6 p.m.

Recent Activities

ALABAMA

FEDERAL PROJECTS NOW authorized for Alabama will provide 910 miles of inland water routes and a tremendous supply of electric power, Col. W. K. Wilson, Jr., chief of the Mobile District of the U.S. Engineer Office, said in a leading talk given at the Section's recent annual meeting in Mobile. Development of this mileage of inland waterway channels will require the construction of 18 locks and 18 dams, with total energy output of 1,100,000,000 kw hr, Colonel Wilson told the group. Tentative plans are also under way, he said, for the $170,000,000 Tennessee-Tombigbee Waterway that would create a slackwater barge canal from Mobile north to the Ohio and upper Mississippi Rivers. Another feature of the two-day program was a symposium on the port of Mobile, presented by the Hon. Frank Boykin, member of Congress, Henry W. Sweet, director of the Alabama State Docks and Terminals; W. B. Garner, executive vice-president of the Waterman Steamship Corp.; W. O. Dobbins, director, State Planning Board; and O. L. Adams, chief of the Operative Division of the Mobile Engineering District. During the business meeting ASCE Director Edmund Friedman spoke on Society affairs. New Section officers are Arthur Beck, president; J. B. Converse, first vice-president; G. P. Willoughby, second vice-president; and John Clark, secretary-treasurer.

AKRON

THE FUNCTIONING OF the Akron Council of Engineering and Scientific Societies was described at a recent meeting by E. D. Barstow. Section President M. P. Lauer reviewed the ASCE Fall Meeting in Washington and discussed the achievements of the District 9 meeting at Clifty Falls in the autumn.

ARIZONA

NEW ARIZONA SECTION officers are John Girand, Phoenix, president; Paul F. Glendenning, Prescott, vice-president; and Dario D. Travaini, Phoenix, secretary-treasurer.

Scheduled ASCE Meetings

SPRING MEETING
Los Angeles, Calif., April 26–29
(Board of Direction meets April 24–25)

ANNUAL CONVENTION
Toronto, Canada, July 12–14
(Board of Direction meets July 10–11)

FALL MEETING
Chicago, Ill., October 11–13
(Board of Direction meets October 9–10)

BUFFALO

PRESENTATION OF CERTIFICATES of life membership to S.T.M. Carpenter, Arvin J. Dillenbeck, and Arthur P. Skaer was a highlight of the Section's annual luncheon meeting. The following officers were elected for 1950: Harold I. Howell, president; Herbert F. Darling, vice-president; Robert T. Moore, secretary; and William G. Seyfang, treasurer.

CENTRAL ILLINOIS

THE PETENWELL HYDROELECTRIC Project was discussed at a recent joint meeting of the Section and the University of Illinois Student Chapter by A. P. Geuss and E. M. Cucik, of the Harza Engineering Co., Chicago. Results of the election of officers for 1950 are James G. Clark, president; Lawrence P. Murphy, first vice-president; W. Leighton Collins, second vice-president; and Ellis Danner, secretary-treasurer.

CENTRAL OHIO

A PANEL DISCUSSION on Columbus building codes comprised the technical program at a recent afternoon joint meeting with the Columbus Technical Council. Albert Tietzel presented the view of the prefabricated home producer; Harry L. Creiger spoke on "The Benefits Derived by Adopting a New Code"; Russell E. Barnard reviewed state legislative aspects of building codes; and Emil J. Szendy redefined the objective of a new building code. Guest speaker at the dinner meeting that followed was R. E. Small, of the General Electric Co., who described turbo-jet applications. A technical explanation of television was given at the Section's annual meeting by J. H. Hocker, of Video Station WLW. New Section officers, installed during the evening, are J. F. Barbee, president; Howard E. Bonham, first vice-president; Emmett Karrer, second vice-president; and Kenneth B. Anderson, secretary-treasurer.

COLORADO

A CERTIFICATE OF life membership was presented to Clyde E. Learned, past-president of the Colorado Section, with appropriate ceremony during the Section's annual Ladies' Night celebration. Frederick E. Schmitt, of the Bureau of Reclamation, was a recipient in absentia. The annual election of officers resulted in the selection of John S. Marshall for president; William H. Thoman, vice-president; and August L. Ahlf, secretary-treasurer.

FLORIDA

STREAM GAGING IN Florida was discussed at a recent organization meeting of the Gainesville Sub-Section by A. O. Patterson, district engineer for the U.S. Geological Survey at Ocala, Fla. The

group elected C. D. Williams president, and D. A. Firmage secretary-treasurer. J. E. Chadwick, of the Koehring Co., Milwaukee, spoke on "Capacity and Production Rates of Crane Units" at the group's second meeting. Seven counties are represented in the new Sub-Section.

GEORGIA

THE DESTRUCTIVE EFFECT of heavy rainfall upon various types of soil was described by W. A. Ellison, of the Navy Bureau of Yards and Docks, in an illustrated talk on splash erosion that comprised the program at the January 4 luncheon meeting of the Section. Mr. Ellison, who was formerly with the Soil Conservation Service, likened the destructive effects of such rainfall to the action of termites on wooden structures. He also explained the extensive soil damage caused by scour, sheet, gully, puddle, and fertility erosion.

INDIANA

PERMAFROST CONDITIONS IN Alaska were outlined at a recent dinner meeting by K. B. Woods, secretary-treasurer of the Section and professor of civil engineering at Purdue University. B. A. Poole, retiring president, reviewed the year's activities, and Prof. R. B. Wiley discussed the proposed District 9 Council. Life membership awards were made to George E. Halstead, Arthur D. Kidder, and Lawrence V. Sheridan, and to John W. Toyne and Walter L. Hempelmann in absentia. New Section officers, unanimously elected during the meeting, are D. E. Bloodgood, president; D. M. Corbett, vice-president; E. C. Thoma, secretary-treasurer; and C. H. Canham, assistant secretary.

INTERMOUNTAIN

A BRIEF TALK on the Armco Drainage and Metal Products Co. by Frank Randle, engineer for the organization at Salt Lake City, and the showing of a film, "Clean Waters for Utah," constituted the technical program at a recent meeting of the Intermountain Section. The group has elected the following officers for 1950: George P. South, president; Cleve H. Milligan, first vice-president; and R. E. Simpson, second vice-president. C. E. Painter carries over as secretary-treasurer for another year.

KANSAS

EXPERIMENTAL PROJECTS CONDUCTED by the Kansas Highway Commission were described at a recent Section meeting in Topeka by R. L. Peyton, concrete engineer for the Commission. During the evening F. A. Russell received a life membership award.

TOTAL MEMBERSHIP AS OF JANUARY 9, 1950

Members	7,489
Associate Members	9,636
Corporate Members	17,125
Honorary Members	39
Juniors	10,584
Affiliates	75
Fellows	1
Total	27,824
(January 10, 1949	24,884)

KANSAS CITY

ASCE PRESIDENT-ELECT ERNEST E. Howard attended the annual meeting of the Kansas City Section and spoke briefly. During the business session the following officers were elected for 1950: Mark C. Culbreath, president; John Q. A. Greene, first vice-president; Reed McKinley, second vice-president; and William L. Patterson, secretary-treasurer.

KENTUCKY

VARIOUS PHASES OF floodwall design were presented at the Section's annual meeting in Louisville by a panel of speakers connected with the Louisville District office of the Army Corps of Engineers—S. M. Bailey, W. A. Heitmann, and S. F. Farmer. Slides and drawings were used to illustrate features of Corps of Engineers floodwalls and appurtenances. The Section endorsed the candidacy of D. V. Terrell, dean of the college of engineering of the University of Kentucky, for Society Vice-President next year and unanimously elected the following slate of officers: J. Frank Grimes, president; Craig P. Hazelet, vice-president; Lowell E. Gregg, secretary-treasurer; and William B. Drake corresponding secretary. A certificate of life membership went to Homer Puckett.

MARYLAND

THOUGH THE PUBLIC benefits greatly from engineering knowledge, engineers in general have too little public contact, ASCE President Franklin Thomas told members of the Section at a recent dinner meeting. Speaking on the "Engineer in Public Life," President Thomas emphasized the fact that, "The engineer could make better use of the profession and his knowledge by getting closer to the public and obtaining proper recognition. This recognition is best achieved," he said, "by individuals rather than by groups, and such individual action is best taken through civic organizations and responsibilities." Commenting on the trend toward a lowering of ASCE age groups and particularly toward a large Junior membership, President Thomas urged increased Local Section attention to Junior interests and activities.

METROPOLITAN

Technical and professional aspects of the architect-engineer relationship were explored at the December meeting by Harold D. Hauf, editor-in-chief of *Architectural Record* and former professor of architectural engineering and chairman of the department of architecture at Yale University. Mr. Hauf drew upon experience in private practice, government service, and the educational field for his discussion of the coordinated efforts of the two groups on joint ventures.

MIAMI

MIAMI SECTION SECRETARY William C. Gordon was elected president for 1950 at the Section's annual meeting on December 1. Succeeding him as secretary-treasurer will be Earl J. Reeder. Retiring President Perry reported the Local Section Conference in Washington, D. C., Prof. Murray Mantell, of the University of Miami, then discussed the Miami building code, which is being revised, and suggested the recommendation of certain engineering provisions in the new code. The matter will be studied by a committee.

NORTHEASTERN

JUNIORS OF THE Northeastern Section sponsored a recent Section dinner meeting at M.I.T. The principal speaker was Ray Moeller, who described his experiences on a sailing voyage around the world from an engineering viewpoint. William Lambe was chairman of the meeting. The annual Student Night, sponsored jointly by the Section and the Boston Society of Civil Engineers, was attended by more than 300 students. Speaker for the occasion was the Reverend Daniel Linehan, seismologist in charge of the Weston College Seismological Observatory, who discussed earthquakes and the application of seismic surveys.

NORTHWESTERN

RESEARCH AND OTHER problems confronting the University of Minnesota Institute of Technology were outlined at the annual meeting of the Section by Dean Spilhaus of the Institute. The rest of the technical program consisted of the showing of colored films made by Section member Harvard S. Rockwell on a recent trip to Europe. The election of officers for 1950 resulted as follows: Frank S. Altman, president; Charles W. Britzius, first vice-president; George V. Guerin, Jr., second vice-president; and Thomas R. Klingel, secretary-treasurer. Guests of the Section included ASCE Director Gordon H. Butler, Duluth, and H. E. Farnham, president of the Duluth Section.

The Junior Forum of the Section reports varied monthly programs, including a talk by Harry D. Lovering, president of the Lovering Construction Co., St. Paul; an inspection tour of Steel Structures, Inc., distributors of Stran Steel Products; and a film on printing, followed by a visit to a newspaper plant. At its annual meeting the group elected Willis Jacus president, and Alice Jarvis, secretary.

OKLAHOMA

ASCE AFFAIRS WERE reviewed at the Section's recent two-day annual meeting in Tulsa by Webster L. Benham, Director for District 14. The election of officers, held during the business meeting, resulted in the selection of Walter C. Burnham for president; David B. Benham, vice-president; and J. E. Lothers, secretary-treasurer. Chairman of the Oklahoma City Branch for 1950 will be Thomas G. Banks, and secretary-treasurer A. C. Commander. Donovan P. Grosshans was elected chairman of the Tulsa Branch, and Donald Curtis secretary-treasurer. One technical session consisted of the showing of moving pictures made by the Kansas City, Tulsa, and Little Rock Districts of the Corps of Engineers, and papers on a variety of subjects by T. B. Shoebotham; Prof. M. D. Creech and James O. Melton, of the University of Oklahoma; and Royce J. Tipton. Papers by students at the Oklahoma A. & M. College and the University of Oklahoma and inspection of the First National Bank Building now under construction in Tulsa comprised a second technical session.

ST. LOUIS

ASCE VICE-PRESIDENT ROBERT B. BROOKS attended the annual dinner meeting of the St. Louis Section and presented life membership awards to Raymond G. Alexander and Arthur A. Miller. The Section was then entertained by Daniel Bartlett, local attorney and humorist, whose topic was "The Problems of the Wife of a Civil Engineer." Officers for 1950 are Col. Malcolm Elliott, president; A. Frederick Griffin, vice-president; Henry M. Reitz, secretary-treasurer; and Harold L. Lien, councillor. J. W. Hubler and Bengt F. Friberg carry over as senior vice-president and senior councillor.

SAN DIEGO

THE ANNUAL MEETING of the San Diego Section was devoted to the reading of committee reports and to business discussion. Election of new officers resulted as follows: J. F. Jorgensen, president; G. E. Arnold, first vice-president; E. A. Lawrence, second vice-president; R. H. Wilken, secretary; and R. K. Fogg, treasurer.

SEATTLE

ENGINEERING AND ARCHITECTURAL features of the Seattle-Tacoma International Airport were described at a recent dinner meeting by George T. Treadwell and S. Charles Dearstyne, chief engineer and assistant engineer for the Port of Seattle. Designed to relieve the overcrowded facilities of Boeing Field, the Seattle-Tacoma Airport has been developed by the City of Seattle through the Port Commission since the war on the site of a CAA field at Bow Lake south of the city. An average of 100 flights a day is currently handled at the field, which has a capacity of 500 flights without further expansion. The City of Tacoma contributed to the development of the field, but financing and operation are largely by the Port of Seattle. Section officers for 1950 are George I. Teufel, president; Samuel DeMoss, vice-president; Robert O. Sylvester, secretary; and James H. Reid, treasurer.

TENNESSEE VALLEY

PRESTRESSED PRESSURE CONCRETE was discussed at a recent dinner meeting of the Muscle Shoals Sub-Section in Florence, Ala., by William A. Sego, Jr., of the Pressure Concrete Co. Later Mr. Sego headed an enthusiastic round-table discussion of the subject. At another recent meeting of the Sub-Section, the program consisted of the showing of a film on malaria control in the Tennessee Valley.

TOLEDO

WILLIAM HASSELBACH, CHIEF engineer of the Libbey-Owens-Ford Glass Co. and a member of the Section, described a recent trip to Europe at the Section's annual meeting and showed numerous colored slides of engineering projects he had made. In the balloting for new officers C. E. Pettis was elected president; and J. C. Webber second vice-president. Clair A. Shaler moves to first vice-president, and C. H. Kurtz remains as secretary-treasurer.

WISCONSIN

IN A TALK given at the Section's annual meeting, ASCE Director Gordon Butler discussed recent developments in the Society, ASCE trends, and what's ahead for 1950. He also presented life membership awards to James L. Ferebee, Albert L. Larsen, and T. McLean Jasper. Election of officers for 1950 resulted as follows: Fred M. Sloane, president; Charles W. Yoder, first vice-president; Carl R. Holdampf, second vice-president; and Ralph H. Boeck, secretary-treasurer.

VIRGINIA SECTION

ART AS WELL as engineering skill is an essential adjunct to successful bridge building, D. B. Steinman, New York City consultant and veteran bridge builder, told engineers attending a recent joint meeting of the Virginia Section and the Engineers Club of Hampton Roads at Norfolk. Dr. Steinman illustrated his lecture with colored slides of drawings for his bridges and the completed structures, and explained the elements of harmony in their design. Stating his preference for the suspension bridge, he said that, "Steel is at its greatest efficiency under tension. The suspension bridge utilizes tension, thus making a stronger bridge with less material and greater economy, and providing more opportunity to achieve beauty." Dr. Steinman also discussed the effect of aerostatic and aerodynamic wind forces.

GUEST SPEAKER D. B. STEINMAN (third from left) is shown with presiding officers at recent joint meeting of Virginia Section and Engineers Club of Hampton Roads. With him, in usual order, are former ASCE Director W. R. Glidden; J. H. Coster, president of Engineers Club of Hampton Roads; and D. S. Wallace, president of Virginia Section.

TEXAS SECTION

UNIVERSITY OF TEXAS graduates—Lowber Snow, president of Texas Section and Ernest E. Howard, president of ASCE—get together during Annual Meeting in New York.

WEST VIRGINIA

DEVELOPMENTS IN COAL mining from the old "pick and shovel" days to the highly mechanized methods of the present were detailed at a recent dinner meeting in Huntington by Gerald von Stroh, director of the Mining Development Committee of Bituminous Coal Research, Inc. Commenting on the shortage of engineers in the industry, Mr. von Stroh pointed out there is a wide field for the engineer because of the extent and complexity of present-day mining operations. J. N. Wallace, president of the Section, spoke briefly on the Local Section Conference in Washington.

STUDENT CHAPTER *Notes*

IOWA STATE COLLEGE

THE CHICAGO SOUTHSIDE Filtration Plant, the International Harvester's Wisconsin steel mill, the Chicago and Northwestern Railroad hump yards, and the Southwest Sewage Disposal Plant were among the engineering and industrial projects visited by members of Iowa State College Student Chapter on a recent three-day inspection tour of the Chicago area.

UNIVERSITY OF COLORADO

Prestressed concrete was discussed by Carlos Bullock, regional structural engineer for the Portland Cement Co., Kansas City, Mo., during a recent meeting of the University of Colorado Student Chapter. Mr. Bullock illustrated his talk with a motion picture of a European airplane hangar incorporating its use. A group of 50 Student Chapter members were conducted on a field trip to the eastern section of the Big Thompson project at Estes Park, Colo., by H. D. Haley, construction supervisor for the Bureau of Reclamation. Experiences during summer employment were described by Chapter members Gene Goley, Kenneth Newman, and Sarb Singh at another recent meeting. The Chapter now boasts a membership of 285, approximately 63 percent of the civil and architectural engineering students.

BROOKLYN POLYTECHNIC INSTITUTE

DESIGN OF TURBO-GENERATOR foundations, a subject not regularly given in the engineering curriculum because of its specialized scope, was the topic of a talk presented before a recent meeting of the Brooklyn Polytechnic Institute Student Chapter (evening group) by Matthew Piracci, a BPI graduate. The technical program was preceded by a business session. There were 40 student members in attendance.

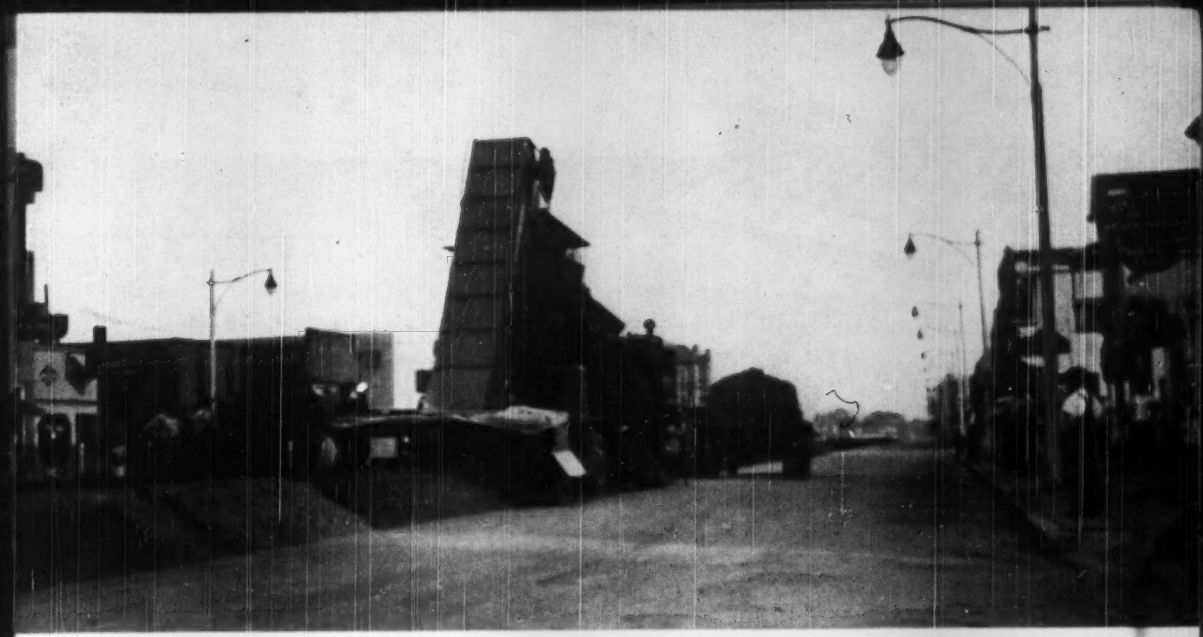
STANFORD UNIVERSITY

THE STANFORD UNIVERSITY Student Chapter concluded an active autumn quarter with the annual initiation banquet, which was held in honor of Leon B. Reynolds, professor of hydraulic and sanitary engineering, who is retiring in June (see News of Engineers department). Professor Reynolds recalled the history of early civil engineering organizations at Stanford and of the ASCE Student Chapter, founded in 1920. A surprise token of appreciation and good wishes was presented to him in the form of a scrapbook, containing 130 letters. The Chapter also voted to start a Leon B. Reynolds library fund for the purchase of civil engineering books. Newly elected officers for 1950—installed at the banquet—are President Edward Jones, Vice-President Guy Anderson, Recording Secretary Earl Hagadorn, Corresponding Secretary Robert Newman, and Treasurer Max Rothe.

JOHN HOPKINS UNIVERSITY

BENEFITS OF MEMBERSHIP in a Student Chapter were stressed by Prof. Thomas F. Hubbard at a recent meeting of the Johns Hopkins University Student Chapter. Recent inspection trips have included the Friendship International Airport, where particular attention was given the terminal building, and drainage structures and runways, and the Baltimore water-supply project. Other activities of the Chapter include a Civil Aeronautics Administration motion picture on "Our Town Builds an Airport"; a speech on the development of the water wheel by C. F. Merrian, of the Pennsylvania Water and Power Co.; and a discussion on the development of oil in Arabia by Don Brown, Arabian-American Co. engineer.

MEMBERS OF Johns Hopkins University Student Chapter ride in "mucking car" on way to working face of Baltimore, Md., Montebello-Patapsco Water Tunnel construction project, where drilling, blasting, and lining operations were observed.



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WIDE economies
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HANDSOME durable roads

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NEWS BRIEFS

Construction Total for 1949 Placed at More than $19.3 Billion

NEW CONSTRUCTION IN the year just passed reached a record dollar value of more than $19.3 billion, according to joint estimates of the Department of Commerce and the Labor Department's Bureau of Labor Statistics. This record high is attributed to public expenditures of nearly $5.3 billion, a rise of more than a billion dollars over the 1948 total, which offset a half-billion-dollar decline in private construction to a total of $14 billion.

In spite of the record number of new dwelling units put under construction during the year, the total of $7 billion spent for private housing in 1949 was 3 percent less than the 1948 total. This drop in expenditures is said to result primarily from the fact that a considerable volume of work on new buildings was left over from 1949 when housing activity was at its peak.

A marked decline in construction of new factories, warehouses, and store buildings in 1949 is reported. However, the joint estimate points out that the large contra-seasonal volume of contracts awarded during the past few months indicates that the downward trend in the building of commercial structures may have been halted.

Except for substantial curtailment of telephone and telegraph construction, an increase in new construction put down by privately owned public utilities in 1949 is reported. Electric and gas companies, in particular, carried out large expansion programs. Railroads, on the other hand, spent only slightly more for new construction than in 1948.

Federal, state, and local public agencies combined spent 25 percent more for new construction in 1949, with new school and hospital building accounting for more than half of the increase.

On the basis of a less-than-seasonal decline of 9 percent in construction activity in December, the two departments predict that, weather permitting, the volume of construction activity during the rest of the winter will continue at a high level. The total value of new construction put in place during the month amounted to over $1.6 billion, a rise of 11 percent over the total for December 1948. Private construction, with a decline of only 5 percent from the November 1949 total, showed more strength than public construction, which dropped 18 percent.

Effect of Climate on Building Industry Studied at BRAB Conference

SEVERAL HUNDRED ENGINEERS, architects, and builders from all parts of the country met with climatological experts in Washington, D.C., on January 11 and 12 for a discussion of the weather as it affects building problems. The first of a series of research correlation conferences sponsored by the newly organized Building Research Advisory Board, the two-day meeting was aimed at giving the different investigators an idea of what is being done to make building conform more effectively to its climatic environment. Dr. C. F. Rassweiler, vice-president in charge of research for the Johns Manville Corp., served as conference chairman.

The technical program was opened with three reports on recent climatological research that indicated wide need for further studies in developing a more precise adaptation of building design to meteorological conditions at the site. Another discussion brought out the fact that climatic variations within a single metropolitan area are sometimes greater than between cities, showing that for design purposes climatic details within an area must be studied.

Another session was devoted to discussions on roofing materials by H. R. Snoke, of the National Bureau of Standards; on insulation by Frank B. Rowley, director of the Engineering Experiment Station at the University of Minnesota; on experimental houses in Austin, Tex.; by F. E. Giesecke, M. ASCE, consulting engineer of New Braunfels, Tex.; and on a building test program by Robert F. Legget, M. ASCE, director of the National Research Council of Canada. In the same session Francis W. Reichelderfer and H. C. S. Thom, chief and climatological specialist for the U.S. Weather Bureau, explored the possibility of further application of available weather data to building problems. They stated that the lack of clear definition of the kind of information required for the purpose has been the chief obstacle to obtaining such data, and suggested further work along that line.

At the conclusion of the conference Dr. Rassweiler summarized the situation for building technology, and Mr. Reichelderfer for the weather sciences. Both emphasized the need for further study of available data and for closer cooperation between the two groups.

Large Construction Budget Requested by President

CONGRESSIONAL APPROVAL OF $3.34 billion for public works construction in the fiscal year 1951 is sought by President Truman. The proposed budget, the largest on record, exceeds by 16 percent an estimated construction expenditure of $2.89 billion for the present fiscal year.

Despite the size of the request for funds, few new construction projects are planned. Exceptions include an appropriation of $7,000,000 to the Tennessee Valley Authority to initiate construction of Boone and Fort Henry dams on the south fork of the Holston River; $5,000,000 to the Bonneville Power Administration for power construction in southwest Oregon; and an appropriation of $6,000,000 for the St. Lawrence Seaway and power project, which has not yet received Congressional approval. In addition to funds for power projects, the President requests new construction totaling $89,000,000 for the Atomic Energy Commission, with an expenditure of $45,000,000 in 1951, principally at Oak Ridge. Also asked is a $45,000,000 construction program for the Civil Aeronautics Administration with $15,500,000 scheduled for expenditure in 1951.

The largest appropriation would go to the Army Corps of Engineers, which is scheduled to spend $534,000,000 for flood control and $161,000,000 for navigation projects. Two Columbia River dams, McNary and Chief Joseph, and Fort Randall and Garrison dams on the Missouri are given the largest allotments on the Corps of Engineers list.

The President asks for $354,000,000 for the Bureau of Reclamation, an increase of $47,000,000 over its 1950 budget. Top projects on its list are the Missouri River Basin development, $102,000,000; the Columbia Basin, $53,500,000; and the Central Valley Project, $49,500,000.

Philadelphia Firm to Build Large VA Hospital

AWARD OF A $6,527,000 contract for erection of a 500-bed Veterans Administration hospital in Philadelphia to the construction firm of John McShain, Inc., Philadelphia, has been announced by the director of VA's technical service. To be built on an 18-acre site near the University of Pennsylvania Medical School and General Hospital, the project consists of a 4,513,000-cu ft hospital building, an apartment building, nurses' and attendants' quarters, laundry building, valve house and underground fuel tanks, an underground soft-water reservoir, and other maintenance units.

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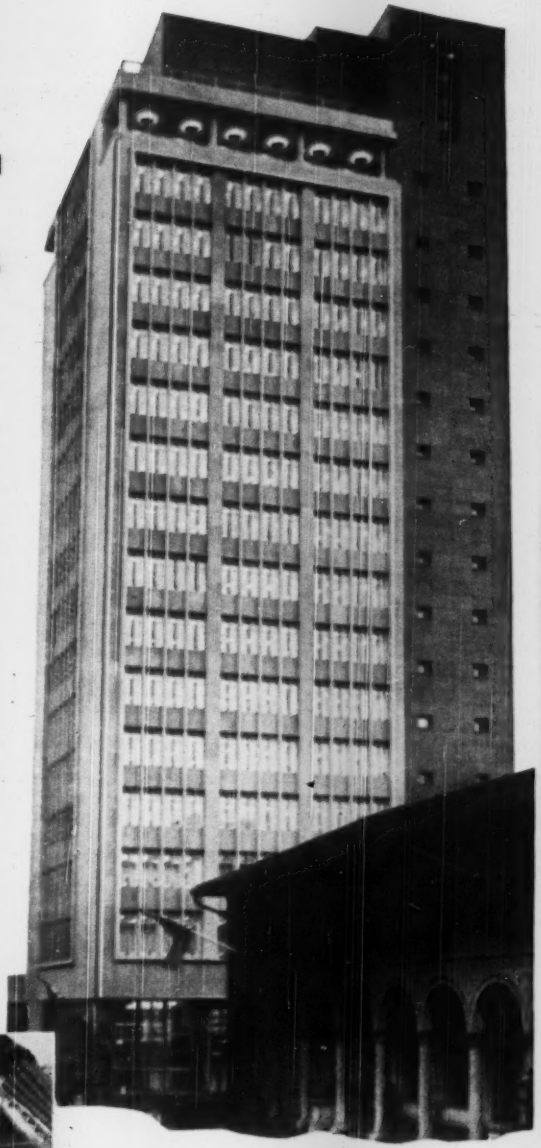
PICTURED here is the beginning and end result of an interesting construction project. The striking, functionally designed structure is one of the most modern office buildings—inside and out—in this country.

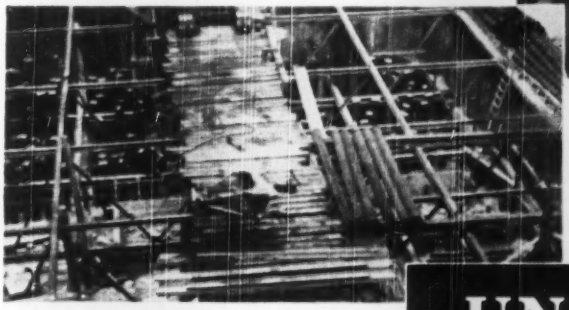
Wise planning went into the foundation of this 18-story building. It included Monotube piles for abundant strength and permanency . . . combined with *practical economy* right from the start.

More and more engineers are turning to the Monotube as a *predictable* pile that leaves no factor to chance. For example, Monotube tapered and fluted design assures measurable advantages in strength, lateral stability, heavy loading and driving . . . benefits that should not be overlooked. Also, Monotubes offer a flexibility of length, gauge, diameter and taper that permits maximum effectiveness *and* economy for varying soil conditions under *all* types of structures.

These are only a few of the important features that you can apply to advantage when you plan with Monotubes. For complete, specific data, write The Union Metal Manufacturing Company, Canton 5, Ohio.



• *Ultra-modern 18-story office building of the Waterman Steamship Corp., Mobile, Ala. (Engineers and General Contractors: J. P. Ewin, Inc.; Consulting Engineer: R. S. Christiansen; Architects: Platt, Roberts & Co.)*



• *Foundation under way, showing use of some 480, 7 gauge Monotube piles, 25 and 30 feet in length.*

UNION METAL

Monotube Foundation Piles

BTEA of New York City Has Annual Meeting

Membership of the National Labor Relations Board is colored with the philosophy of the Wagner Act, making it difficult to obtain "a divorcement of thinking from the old Wagner Act formulas," Robert N. Denham, general counsel for the NLRB, said in the principal address at the annual dinner of the Building Trades Employers' Association of New York City, held in New York on January 12. Eradication of this philosophy "can only be accomplished by a firm determination to abandon it when the principle of the theory has been repudiated, as the Wagner Act and its administration was repudiated by the passage of the Taft-Hartley Act."

Recent decisions of the NLRB in the eyes of many, Mr. Denham pointed out, "has so under cut the real purpose of the Taft-Hartley Act as to amount to repeal by 'decisional attrition.'" The need for cooperation between labor and the employers of the construction industry in the interest of sound and efficient construction was stressed by Mr. Denham. He added "your [BTEA] organization of contractors and labor organizations here that handles your grievances and your jurisdictional disputes, pointed to a pattern, two and one-half years ago, for minimizing one of the most difficult problems presented to the Agency by the Taft-Hartley Act."

Another principal speaker, Peter W. Eller, chairman of the Board of Governors of the BTEA, cited the praise paid American industry by the British delegation that recently made a tour of American construction methods and techniques, under the auspices of the Economic Cooperation Administration. Mr. Eller attributed the "high degree of productivity," to which the delegation referred, to our recovery from a wartime economy and to the elimination of controls that "precluded efficient job planning and produced such costly results." Another factor contributing to the improved industrial picture, according to Mr. Eller, is "an aggressive and extensive apprenticeship system by which thousands of young men, for the most part veterans, have been induced to come into our industry."

Early Deadline Is Set for Engineering Survey

March 15 is announced as closing date for the nation wide survey of selected engineering personnel, which is being sponsored by Engineers Joint Council for the U.S. Office of Naval Research (July 1949 issue, page 48). To date more than 60 percent of the 115,000 questionnaires sent to full members of 18 national engineering societies have been answered and returned. After processing by the American Society of Mechanical Engineers, contracting agent under an ONR agreement, the questionnaires will be kept in Washington as a source file of the nation's leading engineers and scientists.

The survey was initiated as the result of a conference of representatives of EJC and other engineering agencies, held in Washington, D.C., in the fall of 1948, at which was discussed the need for a list of key engineers engaged in research, development, and other scientific projects, who could be called in to work on programs of the National Military Establishment. The results of the EJC survey, however, are not to be construed as an employment register.

Those who have not yet returned their questionnaire are urged to do so before the March 15 deadline, so that their skills may be listed among the engineering resources of the nation. The body of facts assembled by the survey will be available to government agencies, private industrial, educational, and professional society planning groups, and for other similar purposes.

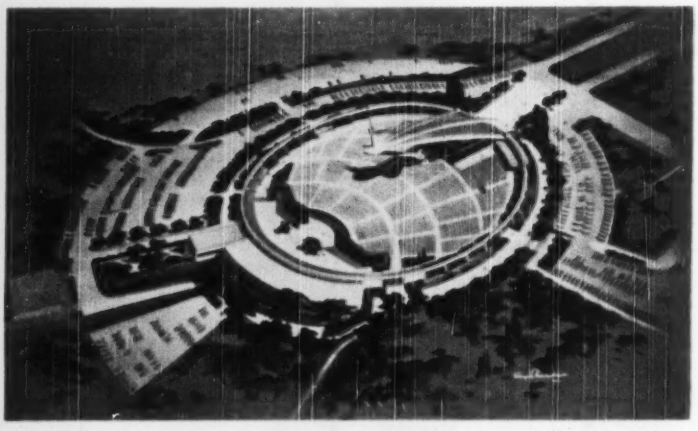
Pittsburgh to Have Large Amphitheater with Retractible Fabric Roof

Design of a large amphitheater with a mechanical, retractible roof of plastic fabric, recently completed for the City of Pittsburgh, will provide permanent facilities for the city's outdoor light opera and protect the opera management from recurrent heavy losses caused by rained-out performances. The first structure of its kind in the world, the amphitheater was designed by Mitchell & Ritchey, Pittsburgh architects, with Ammann & Whitney, consulting engineers, New York City.

The retractible roof support is a giant cantilever steel frame extending from the rear to the center of the amphitheater where it terminates in a central mast overhead, to which the roof's supporting cables are attached. The roof will be in effect a flexible fabric tent, composed of pie-shaped segments that fan out when unfurled from either side of the cantilever frame. A new synthetic fabric, offering high tensile strength and resistance to flex, weathering, and atmospheric conditions, is planned for the roof covering. The fabric roof will have a radius of 185 ft, leaving a 12-ft gap around the amphitheater where a huge circle of planting pockets serves as a continuous gutter.

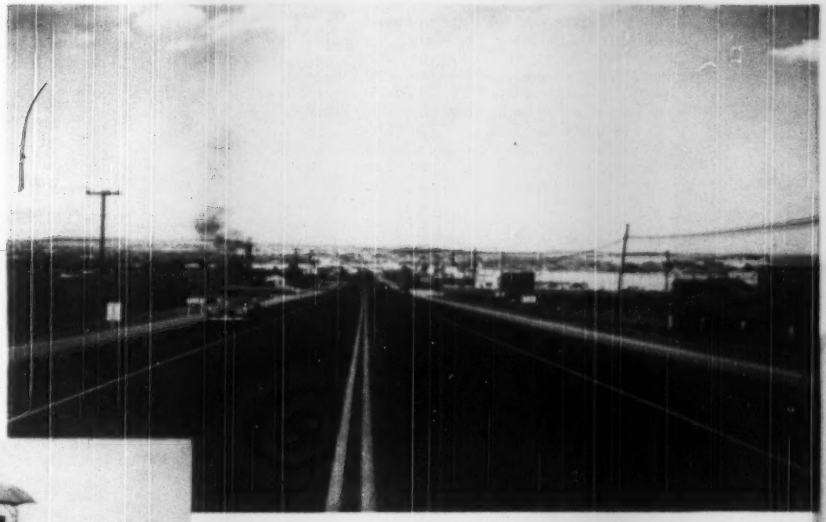
Tracks to carry the cable trolleys and the tractor for the boom, which supports and guides the fabric will be mounted on a circular ring-girder 400 ft in diameter and enclosing the whole amphitheater. Abutments built at 30-ft intervals and circling the amphitheater at a radius of 200 ft support this ring girder. Two rigid structural arms or booms forming the leading edges of the roof are propelled by a pair of 50-hp electric tractors that operate on the ring-girder's boom track. The roof will be unfurled in two halves operating simultaneously, the whole process requiring about 2½ min. Operation will be relatively noiseless.

Selection of a site for the amphitheater and start of construction are expected early in 1950. When completed, the project will provide enclosed protection for an audience of 9,500 and the entire stage with its storage and subsidiary facilities. The sum of $1,000,000 has been made available for the project in equal amounts by the Edgar J. Kaufman Charitable Trust and the City of Pittsburgh. The estimated construction cost of the retractible roof and supporting structure is $542,000.



PROPOSED PITTSBURGH AMPHITHEATER IS SHOWN HERE in artist's rendering, with umbrella completely furled. In this position the roof will be out of sight of the audience, folded in two sections, one on either side of the cantilever frame, as shown here. In the rear area where the cantilever support is visible, there will be no seating, and the space will be used as an inner lobby and for concession facilities. A control booth, suspended from the cantilevered frame, will house operating mechanism for the roof, sound control machinery, and spot lighting. Peripheral illumination will provide additional spot lighting.

How Texas converts *two-lane* highways into *four-lane* superhighways



U. S. Highway 81 near San Antonio, Texas, widened from 20 to 52 feet and resurfaced with Texaco Asphaltic Concrete paving by the H. B. Zachry Company of San Antonio.

A total thickness of 4½ to 7 inches of durable, resilient Texaco Asphaltic Concrete was used in widening and resurfacing this section of U. S. 81.

U. S. 81 is one of Texas' principal north-south highways. It connects the city of Fort Worth with the Mexican border, where it meets the Pan American Highway. Greatly increased traffic made it necessary last year to more than double the width of a 4-mile section near San Antonio.

The method used by Texas in transforming this old two-lane highway into a four-lane superhighway will interest other road builders. A new sub-base was laid to a depth of 8 inches on each side of the old concrete pavement. Over this was constructed a plant-mixed Texaco Asphaltic Concrete foundation 6 inches thick. The old 20-foot pavement itself was covered with a 3½-inch leveling course of coarse-graded Texaco Asphaltic Concrete. Finally, a 1-inch wearing surface of fine-graded Texaco Asphaltic Concrete was laid over the full width of the new 52-foot pavement.

In modernizing this old, narrow highway, Texas takes full advantage of the resilient, durable, joint-free qualities of Texaco Asphaltic Concrete construction. Not only does this type of hot-mix asphalt paving stand up under the heaviest traffic impact for many years, but the cost of maintaining it is consistently low.

For complete information on Texaco Asphaltic Concrete construction, write our nearest office for the booklet, "Texaco Asphalt Paving—Plant-mixed Types."

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Progress in Road Studies Outlined at Meeting of Highway Research Board

PRACTICALLY ALL PHASES of highway economics, materials, design, construction, and traffic were covered in 20 technical sessions highlighting the 29th annual meeting of the Highway Research Board, held recently in Washington, D.C. There was a near record attendance of 800 highway administrators and technologists for the four-day program. First reports of projects outlined for the coming year by committee chairmen show an ambitious program that should make a considerable dent in the stockpile of needed highway research.

Professor Moyer

An easier, faster, and more accurate method for determining soil strength was described at a session on soils research by Lee Schlesinger and Eben Vey, Juniors ASCE, graduate assistant and assistant professor of civil engineering at Illinois Institute of Technology. Reporting their recent experiments in the Illinois Tech laboratories, the speakers stated that the new method provides accurate in-place measurement, eliminating costly, time-consuming laboratory testing methods now in use. By making spot measurements quickly available at any level, they stated, risks, costs, and delays in the construction of buildings, roads, and bridges can be reduced. The new method consists of relating the distribution of soil resistance on the surfaces of a four-faced blade, affixed to a shaft that is turned at a constant rate in the soil, to the measured surface force.

Featured at one of the general sessions was the presentation of Distinguished Service Awards to Prof. K. B. Woods, M. ASCE, of Purdue University, and O. K. Normann, of the Bureau of Public Roads, "in recognition of their contributions to highway research over the past years." The annual Highway Research Board award for the outstanding paper presented at the 28th annual meeting went to F. N. Hveem, Assoc. M. ASCE, and R. M. Carmany, Assoc. M. ASCE, of the California Division of Highways, for their paper on "The Factors Underlying the Rational Design of Pavements."

Prof. R. A. Moyer, Assoc. M. ASCE, research engineer at the Institute of Transportation and Traffic Engineering, University of California, was elected chairman of the Board's executive committee for the coming year, and R. H. Baldock, M. ASCE, Oregon state highway engineer, vice-chairman. New members of the Board's executive committee, elected for three-year terms, are W. H. Root, M. ASCE, maintenance engineer of the Iowa State Highway Commission, and H. P. Bigler, executive vice-president of the Connors Steel Co., Birmingham, Ala.

Synopses of the 90 papers and committee reports presented at the meeting are available in Volume 19, No. 11, *Highway Research Abstracts*, for 30 cents. Requests should be directed to the offices of the Board, 2101 Constitution Avenue, N.W., Washington 25, D.C.

Truman Appoints Water Resources Commission

A TEMPORARY SEVEN-MEMBER Water Resources Policy Commission has been appointed by President Truman to study and make recommendations to him on existing federal legislation and policies in the water resources field. Though the commission will deal principally with the large-scale water problems of the West, the current water shortage in New York City is cited as the sort of problem that should be considered under the heading of federal participation in municipal water supply projects.

Samuel B. Morris

The Executive order establishing the commission states that it shall give consideration in particular to (1) the extent and character of federal government participation in major water resources programs, (2) an appraisal of the priority of water resources programs from the standpoint of economic and social need, (3) criteria and standards for evaluating the feasibility of such projects, and (4) desirable legislation or changes in existing legislation.

Membership of the committee is as follows: Morris L. Cooke, Philadelphia engineer, chairman; R. R. Renne, president of Montana State College; Lewis W. Jones, president of the University of Arkansas; Gilbert White, president of Haverford College; Samuel B. Morris, M. ASCE, Department of Water and Power, Los Angeles, Calif.; Paul S. Burgess, dean of the University of Arizona College of Agriculture; and Leland D. Olds, New York.

Massachusetts Engineers Polled on Registration

A VOTE OF confidence by Massachusetts engineers in the state's existing permissive registration law for professional engineers was the result of a recent state-wide referendum sponsored jointly by the Engineering Societies of New England and the Massachusetts State Society of Professional Engineers. The ballot summarized arguments for and against mandatory registration and asked whether the voter favored or opposed the mandatory type for Massachusetts. Out of 10,200 ballots mailed, 4,281 (42 percent) were returned.

Of the replies, 1,820 favored the mandatory law and 2,355 opposed it. Seventy-seven ballots were invalidated. This was conclusive indication of support of the present permissive law.

An interesting feature of the balloting was identification of each vote by the particular society to which the voter belonged. By this means, each of the separate societies or Local Sections in the state was able to gage the reaction of its members to this vital question. Of 24 such units, the members of 18 polled a majority against the mandatory form, while six favored it.

Massachusetts and New Hampshire are the only states that have permissive registration laws for professional engineers. All others have a mandatory form, including Kansas which originally had a permissive law and changed it to a mandatory law a few years ago.

AICE Elects 1950 Officers at Annual Dinner Meeting

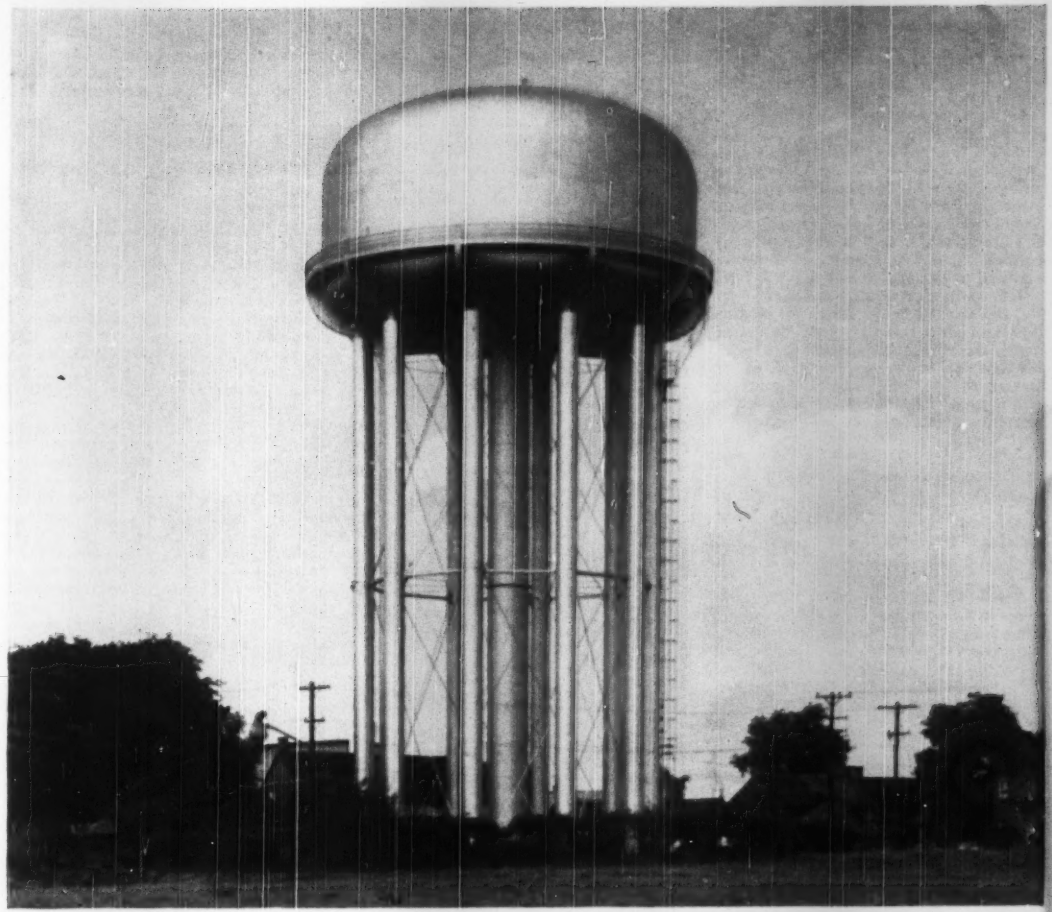
LESLIE G. HOLLERAN, M. ASCE, partner in the New York City consulting firm of Clarke, Rapuano & Holleran, was elected president of the American Institute of Consulting Engineers at the annual dinner meeting of the organization held in New York on January 16. Other new officers are E. P. Goodrich, M. ASCE, vice-president, and George C. Diehl, treasurer. R. E. Bakenhus, M. ASCE, continues as secretary.

The address of the evening was given by Sumner Pike, of the U.S. Atomic Energy Commission, who discussed "The Non-Military Aspects of Atomic Energy."

"CARE" Aids in Sending Technical Books Abroad

AMERICAN ENGINEERS ARE reminded that there is still demand from universities and libraries abroad for technical and scientific books in English to replace collections destroyed in the war. To facilitate the sending of such books abroad CARE, in cooperation with UNESCO, is continuing to act as a purchasing and distributing agency, using funds provided here for purchase and delivery of the latest and best books published in English. Purchases are made on the specific advice of CARE and UNESCO representatives abroad who have queried libraries, technical schools, and universities on their book needs in specified categories recommended by reconstruction experts.

Cash donations in any amount can be sent to the Book Program, CARE, 20 Broad Street, New York. Contributions under $10 are pooled in a general fund, but donors of $10 or more can specify the country, institution, and type of book.



Now the Water Pressure is UNIFORM in Frederick

The maximum pressure variation in the water mains at Frederick, Maryland, was 18 lbs. per sq. in. during a typical 24-hour period before the 1,000,000-gal. Horton tank shown above was added to the system. Now the variation is only 6 lbs. per sq. in. Furthermore, the average pressure in the distribution mains—now about 67–68 lbs. per sq. in.—is higher than it was before the tank was placed in service. (All figures taken from pressure recorder charts.)

This tank also reduces pumping costs. In the words of the City Engineer "our pumping time is now about one-half what it was before." The tank at Frederick is filled during the night with water flowing by gravity from nearby mountain sources. Even if there aren't any hills handy to provide a gravity supply, elevated storage usually reduces pumping costs because the operation of pumping equipment can be spread out into off-peak periods when power rates are lowest.

Frederick illustrates how a community benefits when the designing engineer decides to provide elevated water storage facilities in its water distribution system. The next time you're working on a municipal or industrial water distribution problem remember that a Horton elevated tank may be the answer. These radial-cone bottom tanks are available in standard capacities from 500,000 to 3,000,000 gallons. Write our nearest office for the illustrated bulletin describing them.

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Chicago 4	2199 McCormick Bldg.	Los Angeles 14	1556 General Petroleum Bldg.
Cleveland 15	2263 Guildhall Bldg.	New York 6	3365—165 Broadway Bldg.
Philadelphia 3	1652—1700 Walnut St. Bldg.		
Salt Lake City 4	309 West 17th South St.		
San Francisco 11	1284—22 Battery St. Bldg.		
Seattle 1	1309 Henry Bldg.		
Tulsa 3	1647 Hunt Bldg.		

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

Large Natural Gas Pipeline Is Put In Operation

RECENT COMPLETION OF an 800-mile gas pipeline, extending from the natural gas fields of the Southwest to Middletown, Ohio, is announced by the Texas Gas Transmission Corp. The 26-in. transmission line, which was built in less than eight months, is the longest constructed and put in operation during 1949. It has an initial daily capacity of 304,000,000 cu ft, which will be increased to 400,000,000 cu ft a day in 1950.

Built at an approximate cost of $73,000,000, the new line brings additional supplies of natural gas to communities in Tennessee, Kentucky, Illinois, Mississippi, Louisiana, and Arkansas in time to meet peak winter heating needs. Ten compressor stations, with a total of 68,000 hp, are required to propel the gas through the new line.

Contract Awarded for Brooklyn Highway Job

A $608,407.25 CONTRACT for preliminary construction of a section of the Williamsburg Bridge connection to the Brooklyn-Queens Expressway in Brooklyn has been let to the Horn Construction Co., of New York City, according to an announcement from Bertram D. Tallamy, Assoc. M. ASCE, state superintendent of public works. The project, which is less than a third of a mile in length, will include construction of foundations for columns for future structures, paving contracts, and construction of a recreational area and various public service utilities.

Dates for Inter-American Sanitary Congress Set

PLANS FOR THE Second Inter-American Sanitary Engineering Congress, to be held in Mexico City, March 16 through 26, have been announced by the Mexican Section of the Inter-American Association of Sanitary Engineering, one of the sponsoring organizations. Other sponsors are the Institute of Inter-American Affairs, the Mexican Department of Hydraulic Resources, the Mexican Division of Inter-American Cooperation, the Mexican Department of Foreign Relations, the Mexican Government, the State of Michoacan, and the Pan American Sanitary Bureau.

Following the pattern of the First Inter-American Congress at Santiago, Chile, in 1948, the agenda includes inspection trips to outstanding sanitary engineering and water works projects in the area and a large exhibit of water works and sanitation equipment as well as a full program of papers. Sanitary engineers and public health and public works officials from all the American Republics will be in attendance.

Further information may be obtained from the Conference Chairman Alberto Ortiz Irigoyen, Calle de Campeche 244, Mexico D.F., Mexico, or to Ralph J. Van Derwerker, secretary, Inter-American Association of Sanitary Engineering, 2001 Connecticut Avenue, N.W., Washington 8, D.C.

Engineering Applications of Photogrammetry Reported at Annual Meeting

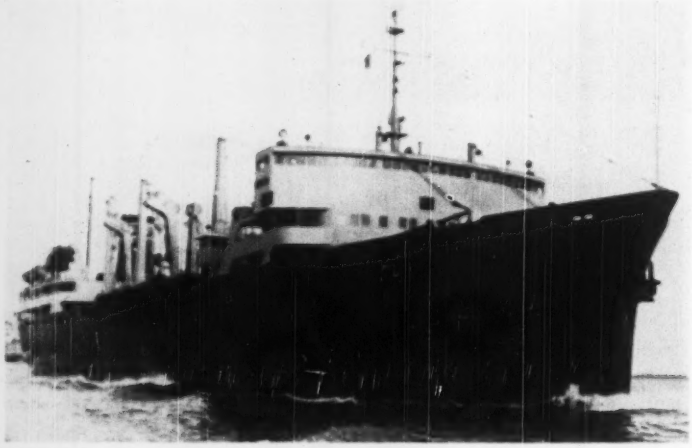
THE NEED FOR standardizing specifications for aerial photography and mapping by photogrammetric methods for highway engineering purposes was stressed by William T. Pryor, Assoc. M. ASCE, highway engineer for the Bureau of Public Roads, in a paper presented at the 16th annual meeting of the American Society of Photogrammetry, held in Washington, D.C., January 11–13. Combining the experience of all concerned with the adaptation of new methods, terms, and techniques to older procedures will aid in attaining such an objective, Mr. Pryor said.

In a paper on "The Uses of High Altitude Photography for Mapping and Reconnaissance," Lewis A. Dickerson, Assoc. M. ASCE, chief of the Photogrammetric Division of the Army Map Service, stated that one of the prime considerations in high altitude photography is economic. Operational military photography is also flown at high altitudes for security reasons, he said.

As an example of what high-altitude photography can mean in time and cost saving, Mr. Dickerson pointed out that, by use of photography from 45,000 ft, an organization of 200 people could complete the aerial photography of the United States, not including finished drafting, in a period of about two years. The total cost up to the drafting stage would be about $2.75 per sq mile, or some $3,500,000 for the 1,200,000 sq miles as yet unmapped. The mapping assumed is for a scale of 1:250,000 with a contour interval of 100 ft.

Among exhibits displayed during the three-day program was a new stereoplotting mechanism, shown by the U.S. Geological Survey, that promises better maps at lower costs. Designated the Twinplex Stereoplotting Instrument, the new apparatus makes use of paired aerial photographs in a modern version of the old parlor stereoscope. According to the Survey, the device is not only more accurate than conventional apparatus now in use, but will enable cartographers to turn out precision maps using almost twice the ordinary working space on each pair of overlapping aerial photographs.

Huge Corps of Engineers Dredge Goes Into Service in New York Harbor



WORLD'S LARGEST DREDGE, "The Essayons," makes its debut in New York Harbor, where it will go into continuous dredging service for Corps of Engineers. More than 50 percent larger than any dredge ever built, the Essayons is 525 ft long and can carry over 8,000 cu ft of dredged material in its hoppers. New features that increase operating speed and efficiency include removable 90-ft-long drag suction pipes that can be raised (though weighing 80,000 lb apiece) and placed in special saddles on deck when not in use, and a 10-in. centrifugal pump that forces out water locked in the hoppers when the bottom gates are closed after disposing of dredged material at sea. The Essayons was formally commissioned by Maj. Gen. Lewis A. Pick, Chief of Engineers, on January 16. Builder was the Sun Shipbuilding & Drydock Co.

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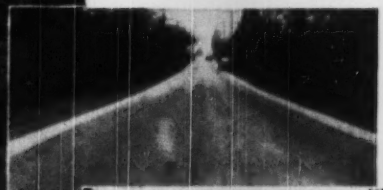

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NEW IN Education

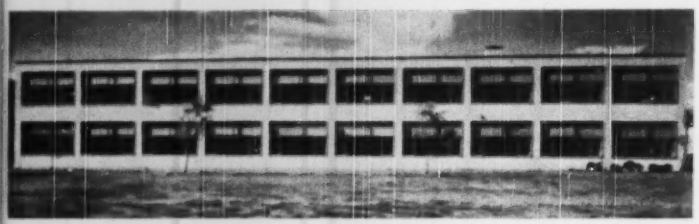
THE CHICAGO UNDERGRADUATE DIVISION of the University of Illinois is conducting refresher courses to prepare structural engineers for the state licensing examinations on March 23 and 24. The University of Illinois, the Illinois Institute of Technology, and Northwestern Technological Institute are cooperating with the Western Society of Engineers in sponsoring the course.

DEAN GEORGE MARSTON, Assoc. M. ASCE, of the University of Massachusetts School of Engineering announced today a $1,500 award from the Research Corp. of New York to be used to investigate yielding in mild steel and soft iron. The work will be carried out under the supervision of Dr. Merit P. White, M. ASCE, head of the department of civil engineering, who will work with Prof. Carl A. Keyser, and James Coffey, instructor in civil engineering.

GEORGIA INSTITUTE OF TECHNOLOGY is offering the first graduate course in port, harbor, and shore engineering to be given in the South, according to an announcement from Dr. Ray L. Sweigert, dean of the Graduate Division. The course will be taught by George F. Sowers, Assoc. M. ASCE, associate professor of civil engineering.

LEADING INDUSTRIALISTS AND engineers who are directing Columbia University's initial campaign for development of a new $12,000,000 engineering center met for a luncheon and report session on January 10. Speakers included Felix E. Wormser, vice-president of the St. Joseph Lead Co., who is serving as chairman of the engineering campaign committee; Dean James K. Finch, M. ASCE, of the School of Engineering; and Prof. John R. Dunning, of the physics department. Faculty members and students of the School of Engineering are conducting separate campaigns with Prof. William J. Krefeld, M. ASCE, heading up the faculty efforts and Lee Prochazka in charge of student participation. The current campaign is directed toward raising $800,000 to complete the purchase of the Sheffield Farms building at Riverside Drive and 125th Street as the first step in building the new center.

Navy Builds Large Supersonic Laboratory at MIT



NEW $2,600,000 Naval Supersonic Laboratory at Massachusetts Institute of Technology houses closed circuit supersonic wind tunnel, approximately 300 ft in length. Laboratory, shown here in partial view, is T-shaped structure, having steel frame with reinforced concrete floor slabs and roof and brick walls. Jackson & Moreland, of Boston, designed and supervised construction of project, which was built under auspices of Navy Bureau of Ordnance. Consulting architects were Anderson & Beckwith, of Boston.

R. Robinson Rowe, M. ASCE

"TEN YEARS," MUSED the Professor. "For just ten years, thru a war and a democratic spending spree, we've met regularly every month to talk of big problems or little problems. We started with a trip to the Northeast Pole, and here we are tonight talking about three ridiculously easy problems in arithmetic. Which one did you do, Joe?"

"Addition's easiest, Professor Neare," said Joe Kerr, "and besides, my hunch clicked. My hunch was that you had framed the setup to make ASCE = 1852, the date of founding. Here's how it works:

CASE		5182
ACES	=	1528
ASCE		1852
SCIE		8562."

"Which can be proved unique," added Ken Bridgewater. "The units column tells that $E + S = 10$, so that there is carry-over in units and tens columns and $A + S = 9$ with carry-over in the hundreds. Substituting the latter in $C + 2A + 1 = S$, the equation of the thousands column, we find $C + 3A = 8$ and $A = 0$, 1 or 2. Now $A = 0$ won't do for initial digits of *ACES* or *ASCE* and $A = 2$ means $C = A$, so we have uniquely $A = 1$.

"The same kind of logic works the division problem:

$$\begin{array}{r} 124\ )\ 259036\ (\ 2089 \\ \underline{248} \\ 1103 \\ \underline{992} \\ 1116 \\ \underline{1116} \end{array}$$

The two 8's were given as 'all of the 8's,' so the topology of the setup quickly limits the quotient to 2089 and the divisor to the range 113 to 124. Now for 113 to 123, the product with 089 ranges from 10057 to 10947, always with zero in the thousands place which would match with the given 8 in the first subtrahend to generate a forbidden 8 in the dividend. So 124 is the only possible divisor."

"If there was an easiest, it's the last problem," complained Cal Klater. Multiplying a number by its units digit simply by transposing that digit to the head end can be formulated:

$$nv = 0.1\,(x - m) + m(10)^{n-1}$$

$$x = \frac{m(10^n - 1)}{10m - 1}$$

Since $10^n - 1$ can be considered an indefinite string of 9's, we can always solve by dividing 9999999...9 by $10m - 1$ until the remainder is zero. In this case $10m - 1 = 59$, a prime, so Fermat's great theorem gives $n = 58$ and therefore $x = 1\,016\,949\,152\,542\,372\,881\,355\,932\,203\,389\,830\,508\,474\,576\,271\,186\,440\,677\,966$. A long sob for a far cry."

"Well done, Joe, Ken and Cal, and I can only add that Fermat's theorem doesn't always give the least solution for primes. Now, if you'll listen to Guest Professor Frack, you'll have something to do for another month."

"Just one evening," promised the Guest Professor. "The Bell boys were racing the Buss boys neck-and-neck in tandem canoes on a 1.6-mile up-river course blazed by buoys every furlong. After passing the midway buoy the Bell boys' troubles began. Ben's bonnet blew off as they passed one buoy and Bill broke his paddle 5 min later at another. Quitting at once, Ben paddled back half-speed for his bonnet, gaffing it at the starting buoy just as the Buss boys came alongside after turning at the goal buoy. How long was Ben bareheaded?"

[Joes, Kens and Cals were: Stoop (John L.) Nagle, A. Nuther Nutt (sic), Bernard Budiansky, G. Nyuss (Robert M. Dodds), Ed C. Holt Jr., M. Verne Reed, R. E. Phillco, Sly Derule (J. I. Gurfein), Anne Othernut, (J. Charles Rathbun), George S. Druhot, J. L. Frack (the Guest Professor), Wm. N. Collier, Van Masce (J. S. Kendrick), James Collins, and Norman O. Geuder.]

Deadlines for Filing P. E. Applications Are Given

ALL PROFESSIONAL ENGINEER applications in New York must be filed on or before March 1 by those seeking admission to the May examinations, and on or before September 1 for the November examinations.

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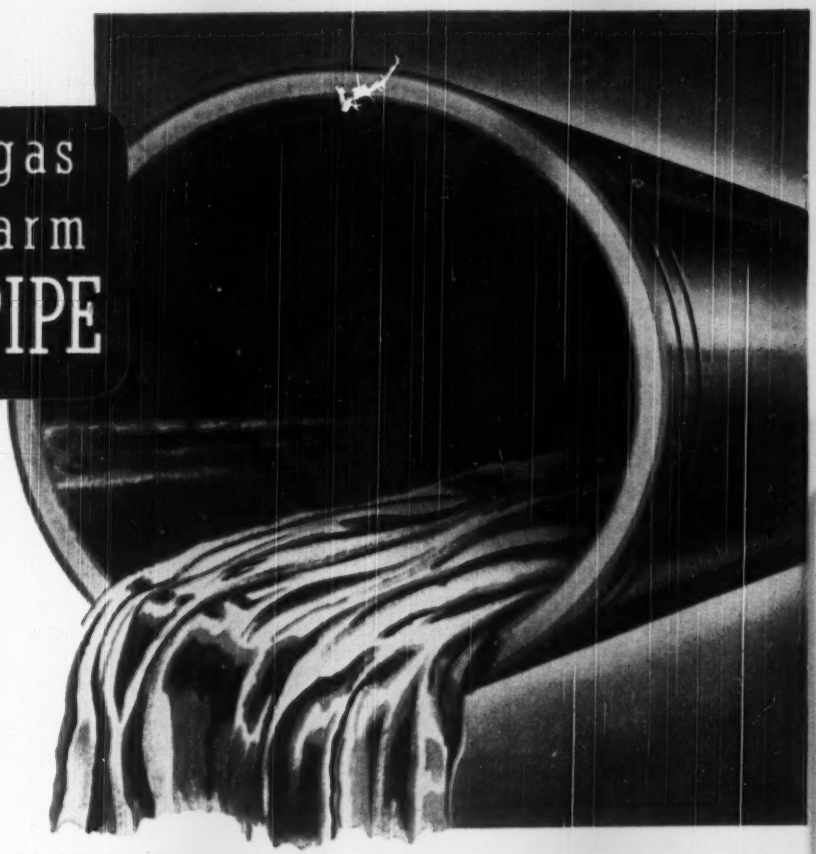

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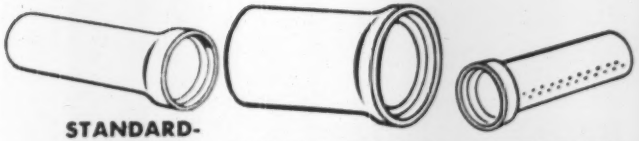

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These deadlines are necessary so that the State Education Department and the State Board of Examiners can process the applications in time for the examinations. Only a serious emergency will justify a waiver. Early filing of applications is recommended and requested, to keep the State Board from being overwhelmed by a last-minute flood of applications.

Contract Is Given for Work on Lavon Dam

AWARD OF A contract for construction of the concrete spillway of Lavon Dam near Dallas, Tex., to the Texas Construction Co., of Dallas, is announced by Lt. Col. Ellsworth I. Davis, Assoc. M. ASCE, Galveston district engineer for the Corps of Engineers. The amount of the contract is $2,034,667.

The completed spillway will be 568 ft long, with twelve 40 by 28-ft gates for discharge of floodwater. The entire dam will be 9,540 ft in length, and the reservoir will flood 20,050 acres. Completion of the project is scheduled for 1952.

Members Named to AEC Advisory Committee

MEMBERS OF A three-man Engineering Advisory Committee, appointed by the U.S. Atomic Energy Commission to assist the Idaho Operations Office of the AEC on planning and development of its Reactor Testing Station, are L. J. Sverdrup, M. ASCE, chairman; Dr. H. M. Crothers; and W. W. Horner, Past-President ASCE.

Both Mr. Horner and General Sverdrup are St. Louis consultants—Mr. Horner as a partner in the firm of Horner & Shifrin and General Sverdrup as president of Sverdrup & Parcel. General Sverdrup is holder of many awards for his wartime service as commanding general of the Engineer Construction Command in the Southwest Pacific. Dr. Crothers is vice-president and dean of engineering at South Dakota State College.

Public Works Program Organized in Alaska

A $70,881,000 PUBLIC works program in Alaska, authorized by the last Congress, has been initiated by the General Services Administration, which recently received an initial appropriation of $5,000,000 for the work. The total program, which is aimed at fostering the settlement of Alaska by providing facilities for community life, will involve construction of between 300 and 400 projects in 100 locations. The proposed program includes schools, colleges, hospitals, libraries, and other institutional buildings as well as usual engineering facilities.

Recently assigned to the project were Arthur D. Morrell, deputy commissioner for planning for the Bureau of Community Facilities, and Lester M. Marx, engineer for the Bureau.

NEWS OF Engineers

Bernard A. Vallerga is now an assistant professor on the faculty of the University of California's Institute of Transportation and Traffic Engineering. Prior to joining the Institute, Mr. Vallerga worked in the materials research field and served in the Army Ordnance during the recent war.

Robert V. Moschell has been appointed city engineer of Alcoa, Tenn.

John H. Morrison and **Joseph A. Maierle** have formed a partnership for the practice of civil engineering under the name of Morrison-Maierle, Inc., with offices in Helena, Mont. The concern succeeds that of the Morrison Engineering Co.

Arvin S. Wellborn is now managing engineer of the Pacific Coast Division of the Asphalt Institute. He will have charge of offices in San Francisco, Seattle, and Los Angeles. Previously Mr. Wellborn served the U.S. Bureau of Yards and Docks.

H. B. Aikin has been advanced in academic rank to associate professor of civil engineering at the University of Tennessee.

Fred Ervast will become Placer County (California) road engineer, as soon as he is released by the Army Corps of Engineers.

Metcalf & Eddy announces that **Scott Keith,** who has been a member of the staff for a number of years, is now a partner in the firm, with headquarters in Boston, Mass.

Mehmet E. Uyanik has joined the faculty of the North Carolina State College's School of Engineering as an assistant professor of civil engineering. Mr. Uyanik, who is a native of Turkey, received his training at the University of Illinois, obtaining his doctorate in 1945.

James Girand, formerly of Phoenix, Ariz., is now with the New York Water Service Corp., with headquarters in New York City.

Howard S. Ives, of North Stonington, Conn., will head the East District of the recently reorganized Connecticut State Highway Commission, and **Elwood T. Nettleton,** of Hamden, the South Central District.

Lawrence E. Goodman is now research assistant professor of civil engineering at the University of Illinois. He formerly was an instructor in civil engineering at Columbia University.

Ernest W. Steel, since 1946 sanitary engineer in the employ of the Venezuelan government, has joined the University of Texas staff as professor of sanitary engineering, to take charge of the sanitary engineering curriculum. A veteran of both World Wars, Mr. Steel attained the rank of colonel of engineers in the recent war.

Harvey F. Ludwig, Los Angeles consultant, has accepted an appointment to the civil engineering faculty of the University of California, at Berkeley. In addition to his teaching duties, Professor Ludwig will conduct seminars and research.

David S. Stoner, who is on leave of absence from the Sacramento, Calif., office of the Bureau of Reclamation for a six-month period, has gone to Formosa at the request of the Nationalist Chinese Government to find new sources of groundwater to be used in connection with the cultivation of cane sugar.

Alfred Mullikin, formerly chief of the sanitary unit of the repair-and-utility section in the Engineer Division of the headquarters of the Sixth Army, Presidio of San Francisco, Calif., has been transferred to the Seattle field office of the Public Housing Administration, as civil engineer.

Harry B. Thorn, after 13 years as contracting engineer in the fabricated steel construction division of the Bethlehem Steel Co., has retired. Prior to his connection with the Bethlehem Steel Co., Mr. Thorn was employed by McClintic-Marshall as an engineer.

Albert A. Miller, for more than 40 years with the Missouri Pacific Lines, has retired as chief engineer of maintenance of way at St. Louis, Mo.

Sumner C. Willis has resigned as chief of construction of the H. K. Ferguson Co., to become associated with the Terminal Construction Corp., Wood-Ridge, N.J., as superintendent on the construction of the sewage disposal plant of the Bergen County Sewer Authority, at Little Ferry.

James F. Spofford has been promoted to superintendent of the Bureau of Reclamation Minidoka Project in southeastern Idaho.

Barton M. Jones has assumed new duties as the chief engineer and general manager of the Miami Conservancy District, with headquarters at Dayton, Ohio. Mr. Jones succeeds **C. H. Eiffert,** who will be retained as a consulting engineer. Since 1942 Mr. Jones has been in Peru as engineer director of the Central Hydroelectric del Can del Pato, the largest hydroelectric development in the country.

W. W. Lane and **R. V. Leeson,** consulting engineers, announce the removal of their offices to 1005 Title & Trust Building, Phoenix, Ariz.

George C. Ashton, previously with the Chicago, Burlington & Quincy Railroad Co., of Chicago, Ill., has been named superintendent of bridges and buildings for Milwaukee, Wis.

Walker R. Young, who retired in 1948 as chief engineer of the Bureau of Reclamation, has been named president and treasurer of the Thompson Pipe and Steel Co., Denver, Colo., where he will direct all operations of the company. During his career of 37 years with the Bureau of Reclamation, Mr. Young served in many capacities, including the preparation of plans and estimates for Hoover Dam and Power Plant and later as construction engineer on the project.

Walker R. Young

(Continued on page 80)

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(Continued from page 78)

Leon B. Reynolds will retire in June as professor of hydraulic and sanitary engineering at Stanford University. Professor Reynolds has been on the Stanford faculty since 1923 and has also served the cities of San Francisco and Santa Clara as a consulting engineer on sewage disposal plant projects. He has written for various scientific journals, and recently was made a life member of ASCE.

Leon B. Reynolds

George Winzler has been appointed resident engineer of Eureka, Calif.

Cyril Thomas has been appointed assistant general manager of the Natomas Co., Natoma, Calif., in charge of gold dredging operations.

John DeArrieta, of Fresno, Calif., has been transferred from the Sacramento office of the Corps of Engineers to construction work on the Pine Flat Dam near Fresno.

Herbert M. Bosch was recently appointed chief of the Section of Environmental Sanitation for the World Health Organization, with headquarters at Geneva, Switzerland. In this capacity, Mr. Bosch will direct programs aimed at international control of the major pandemic diseases associated with unsanitary environmental conditions. Except for a leave of absence from 1941–1945 when in military service, Mr. Bosch has been connected with the Minnesota Department of Health since 1936.

W. Earl Andrews, Ernest J. Clark, and **Frank J. Buckley** announce that the firm name of Andrews & Clark has been changed to Andrews, Clark & Buckley, New York City consulting engineers.

John S. Longwell, who has been with the East Bay Municipal Utility District of California for over 25 years, more recently as chief engineer and general manager, has retired. Before joining the utility District, Mr. Longwell was employed by the United States Reclamation Service.

A special citation for 25 years of service with the Austin Co. was awarded to **Richard Ellis,** vice president and district manager of the Pacific Northwest region, at a recent annual meeting in Seattle, Wash. Mr. Ellis is a past president of the Seattle Section of the Society.

John C. Haberer, of Utica, N. Y., has been appointed district sanitary engineer for Rochester, succeeding George W. Moore, who resigned.

Gordon W. Harvey, chief engineer of the Genesee State Park Commission, Castile, N. Y., has been promoted to chief engineer and general manager in responsible charge of the Commission's activities. Mr. Harvey is vice-president of the Rochester Local Section.

Harry Darby, of the Kansas State Highway Commission, has been appointed to serve the unexpired U.S. Senate term (one year) of the late Senator Clyde M. Reed.

Antonio O. Perez has become proprietor and manager of the Reforma Travel Bureau, Mexico, D.F.

H. R. F. Helland, of San Antonio, Tex., recently announced that a partnership has been formed with **Irving S. Seligman,** who has been Mr. Helland's principal assistant for the past four years. The new firm, Helland & Seligman, Ltd., will continue the general practice of civil engineering, including appraisals, planning and consultation on all types of municipal improvements.

H. M. Witbeck is now director of the municipally owned utilities of Palo Alto, Calif.

Oscar H. Hallberg, assistant city engineer in the Department of Public Works of Tacoma, Wash., has retired after approximately 39 years of service. Mr. Hallberg was affiliated with the Northern Pacific and was in service during World War I.

Dwight F. Metzler has accepted the position of director of the Division of Sanitation of the Kansas State Board of Health, with headquarters at Lawrence.

Carlos D. Bullock has been appointed regional structural engineer for the West Central Region of the Portland Cement Association, with headquarters in Kansas City, Mo. Previously, Mr. Bullock was in the Philadelphia office in a similar position.

Arthur D. Weston has retired as deputy commissioner and director of the Division of Sanitary Engineering of the Massachusetts Department of Public Health. Mr. Weston has been engaged in research and practice in the field of sanitary engineering for the State Health Department for 40 years. He expects to do some consulting work and writing.

J. Paul Buckley, previously highway engineer on the staff of the Automotive Safety Foundation, will succeed **G. Donald Kennedy** as engineering consultant in charge of the survey of highway needs now under way in Ohio, with headquarters in Columbus. Mr. Buckley has been supervising engineer on the project since its inception.

Richard A. Haber, who recently assumed new duties as division engineer of Kent County (Delaware) of the State Highway Department, will have direct supervision of maintenance and construction work on the highways in the county. Mr. Haber joined the department after graduating from the University of Delaware and, with the exception of about a year in private practice, has served for 12 years.

A recent issue of *Look* magazine applauds **Clifford S. Strike,** president of F. H. McGraw & Co. and chairman of Overseas Consultants, Inc., "for his efforts to raise living standards and bring prosperity to the world's underdeveloped areas by the importation of American engineering and technical 'know how'." The write-up concludes, "He's carrying out the aims of Truman's 'Point Four' program . . . yet he's doing it as a private venture."

Clifford S. Strike

Deceased

Louis Edward Bogen (M. '12) former engineer in the electrical department of Allis-Chalmers, Milwaukee, died in Cincinnati, Ohio, on December 3. He was 77. Mr. Bogen held civil and electrical engineering degrees from the University of Cincinnati and Cornell University, and was professor of physics at the University of Cincinnati for several years. In 1901 he joined the Bullock Electrical Manufacturing Co., Cincinnati, which was later taken over by Allis-Chalmers. In 1908 Mr. Bogen transferred to the organization's Milwaukee plant, where he remained until his retirement in 1947.

John Pierce Churchill (M. '11) Apex Steel Corp., Los Angeles, Calif., died on October 22. Mr. Churchill, who was 74, was an alumnus of Michigan State College, and did graduate work at Cornell University. In 1904, after early work with the Northern Pacific and the American Bridge Co., he became chief engineer and plant superintendent of the Hay Foundry & Iron Works, Newark, N.J. He remained there until 1927, and was works manager for the Mosher Steel & Machinery Co., of Dallas, Tex., before going to the Apex Steel Corp. in 1936.

Harry Seykora Comly (M. '17) of San Diego, Calif., died on December 1, at the age of 62. Mr. Comly spent most of his career in highway work here and in Mexico. From 1912 on he was with the California Highway Commission—for many years as district engineer at Redding and, later at San Diego. In World War I he was with the Science and Research Division of the Army Signal Corps.

Vernon Royce Covell (M. '19) retired bridge engineer, died at his home in Wilkinsburg, Pa., on December 21, at the age of 83. A civil engineering graduate of Ohio State University in 1895, Mr. Covell was connected with the Pittsburgh, Cincinnati, Chicago & St. Louis Railroad in Pittsburgh; the Penn Heat & Power Co., of Wilkinsburg; and the County of Allegheny for over 34 years. He was county engineer from 1922 to 1924, then chief engineer of the Bureau of Bridges until his retirement in 1933. During this period many of the major bridges over the Allegheny, Monongahela, and Ohio rivers were designed and constructed. These include the McKees Rocks and George Westinghouse bridges.

Harry Edward Eckles (M. '11) of Chicago, Ill., died recently. A graduate of the University of Illinois, Mr. Eckles had been with the Chicago, Burlington & Quincy Railroad on the Chicago Freight Terminal; assistant engineer in charge of design for the Chicago Board of Local Improvements; and assistant engineer for the Illinois Central Railroad in charge of Chicago Terminal improvement. He had also been with engineering and architectural firms in San Francisco, Kansas City, and Chicago.

(Continued on page 82)

The kind of road people like to ride on — Summer or Winter

When hot Summer suns burn down, motorists appreciate the smooth non-glare surface of roads built with Tarvia* road tar. These roads are always pleasant to look at—pleasant to drive on. They harmonize with any landscape.

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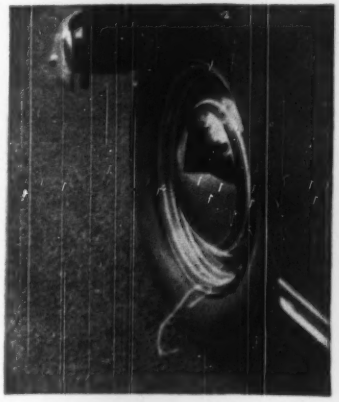

Tires get a better grip on Tarvia* road tar pavement. The slightly granular, "tractionized" surface gives them a firm tread-hold.

Barrett's 46 years of experience in road building, maintenance and repair is yours for the asking. *Ask the Barrett field man.*

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FP 12-7-49 V-J

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(Continued from page 80)

Albert Henry Guillot (M. '31) roadway engineer for New Orleans Public Service, died in a New Orleans hospital recently. Mr. Guillot, who was 59, had been connected with the organization for almost 30 years. He was a member of the Louisiana Society of Engineers and the American Public Works Association, and had been active in the American Legion.

Witt William Hadley (M. '43) bridge construction engineer for the Indiana State Highway Commission from 1920 until his retirement a few months ago, died at his home in Indianapolis on December 3. He was 66. During his 30 years in the department, Mr. Hadley supervised construction of several important Ohio and Wabash River crossings and several railroad bridge projects in the city. He was active in Masonic activities and a former president of the Indiana Society of Professional Engineers. Before going to the highway department, Mr. Hadley was in the Indianapolis City Engineer's office and with the city water company.

Harry Hugh Hadsall (M. '07) retired engineer of Chicago, Ill., died on November 16, at the age of 74. An 1897 graduate of the University of Illinois, Mr. Hadsall was with the Illinois Central Railroad from 1897 to 1907. In the latter year he became connected with the Leonard Construction Co. where he remained until his retirement—for many years as vice-president and secretary.

Alfred Francis Harley (M. '98) retired engineer of Jacksonville, Fla., died in a hospital there on December 22, at the age of 87. Born in London, Mr. Harley was employed by the London & Northwestern Railway before coming to the United States in 1886. In 1888 he went to Jacksonville, which he served for years as city and county engineer. He had had a consulting practice there, and aided in the engineering development of Miami. He served in the AEF in World War I.

Charles Ben Hoech (Assoc. M. '41) of Little Rock, Ark., died on October 3, at the age of 49. Mr. Hoech spent much of his career as resident engineer for the Arkansas State Highway Commission at Little Rock. He had also been with the Lund Engineering Co. there, and during the recent war served as an officer in the Navy Civil Engineer Corps.

Emilio Salvador Jimenez (M. '30) general manager of the American Railroad Co. of Puerto Rico, Santurce, died on July 21, according to recent word. He was 67. Born in Spain and educated at the Federal Polytechnic School of Zurich, Mr. Jimenez spent most of his career in Puerto Rico. From 1908 to 1920 he was in private practice in San Juan, and since the latter date he had been with the American Railroad Co.

Harry Drake Jumper (Assoc. M. '39) chief engineer for Consolidated Rock Products, Los Angeles, and mayor of Arusa, Calif., died recently. Mr. Jumper, who was 53, had been with Consolidated Rock Products since 1923, and chief engineer since 1948. He served in both World Wars, ending his Army Engineer career in 1943 with the rank of major after work on special road-building plans in Central America. He had been active in the American Legion and Masonic organizations and, at the time of his death, was serving his third term as mayor of Azusa.

Brig. Gen. Charles Keller (M. '00) retired Army Engineer of Chicago, died at Coronado, Calif., on September 16, at the age of 81. A veteran Army Officer, General Keller headed early Corps of Engineers surveys of some of the Great Lakes, and in World War I was deputy chief engineer in the AEF. Later he retired and became connected with the Byllesby Engineering and Management Corp. in Chicago, but in World War II was recalled to active duty as District Engineer at Chicago.

William Willett Lewis (M. '10) retired civil engineer of Hyde Park, Mass., died in February 1949, according to word just received at Society Headquarters. He was 82, and an alumnus of Massachusetts Institute of Technology, class of 1889. From 1894 until his retirement in 1934 Mr. Lewis was assistant engineer on the design and construction of the Boston subway system.

Jared Leroy Mathias (M. '42) senior highway engineer for the U.S. Bureau of Public Roads, San Francisco, Calif., died on December 7. Mr. Mathias, who was 63, had been with the Bureau of Public Roads for over 30 years. His work during this period included location and construction of the Lassen National Park road system and other difficult pioneer road projects, and he was manager for the Bureau of California Highway Planning Survey. Mr. Mathias was an alumnus of Colorado State College, class of 1909.

Benham Epes Morriss (Assoc. M. '32) of Norfolk, Va., died on November 21, at the age of 47. Mr. Morriss was a graduate of Virginia Military Institute, and received his master's degree from M.I.T. in 1926. A specialist in indeterminate reinforced concrete structures, Mr. Morriss had been with the Portland Cement Association; area revetment engineer for the Corps of Engineers at Cairo, Ill.; on bank protection of the Mississippi River; engineer for George P. Rice, of New Orleans; and hydraulic engineer for the Tennessee Valley Authority at Knoxville. During the war, he served as an officer in the Army Air Corps.

Rene Armand Nihoul (Assoc. M. '46) director of the Belgian-Luxembourg Center of Steel Information, Brussels, Belgium, was killed in an airplane crash in France in December. Mr. Nihoul was 40 and a civil engineering graduate of the University of Gand, class of 1931. After brief experience as a designing engineer in the office of a Brussels consultant, he became connected with the Belgian-Luxembourg Center of Steel Information. During his years there he headed studies of steel frames in building construction, on the improvement of mill and high-tensile steel for welded construction, and on steel beams.

Homer Martin Parker (Assoc. M. '41) field engineer for the Portland Cement Association, Baltimore, Md., died on October 23. Mr. Parker, who was 57, had been with the Portland Cement Association since 1919. He served in the New York and Philadelphia offices before his transfer to Baltimore about 15 years ago. Mr. Parker was a graduate of Muhlenberg College, Allentown, and early in his career had been with the Traylor Engineering Co. at Allentown, and the Bethlehem Steel Co.

Oscar Garfield Pouch (Assoc. M. '20) vice-president of the American Dock Co. and the Pouch Terminal, both of Staten Island, N.Y., died in a hospital in New Haven, Conn., on December 8, at the age of 67. His homes were at St. George, S.I., and Guilford, Conn. A graduate of Brooklyn Polytechnic Institute, Mr. Pouch founded the Pouch Terminal, a pier-operating company, during the first World War, and for a number of years was an official in the American Dock Co. Active in civic affairs, Mr. Pouch had been president of the Staten Island Chamber of Commerce and, at the time of his death, was a member of Mayor O'Dwyer's Port and Terminal Committee.

Louis Ernest Robbe (M. '23), retired engineer of Larchmont, N.Y., died at Lake Worth, Fla., on January 11 at the age of 68.

Louis E. Robbe

Mr. Robbe was with the City of New York engineering department for 40 years—first with the Board of Water Supply and later the Board of Transportation, retiring in 1946. In the first World War he served as a lieutenant colonel with the AEF in France, and in the recent war was a colonel with Civilian Defense units of the Army in New York City. Mr. Robbe was a graduate of Massachusetts Institute of Technology, class of 1905. He had been active in the Metropolitan Section of the Society and was a Mason and member of the American Legion.

Sidney James Robison (M. '29) of Chicago, Ill., died in that city on December 3, at the age of 70. Beginning in 1919, Mr. Robison was for many years assistant chief engineer for the Universal Atlas Cement Co., Chicago. Earlier he held a similar position with the Illinois Steel Co. As chief engineer of the Pensacola Shipbuilding Co. in World War I, he designed and supervised construction of one of its large plants.

Charles Silliman (M. '10) retired engineer of Norristown, Pa., died on November 28. He was 81. A specialist in railroad work, Mr. Silliman was with the Norfolk & Western Railway for 22 years, and federal valuation engineer for a group of southern railroads for 18 years. He then served as consultant on valuation matters for several railroads, retiring in 1949.

Edward Brinton Temple (M. '07) retired chief engineer of the Eastern Region of the Pennsylvania Railroad, Swarthmore, Pa., died in March 1949, according to word just received at Society Headquarters. Mr. Temple, who was 78, had spent his entire career with the Pennsylvania Railroad. He was a graduate of Swarthmore College, and state chairman for Pennsylvania of the Association of American Railroads.

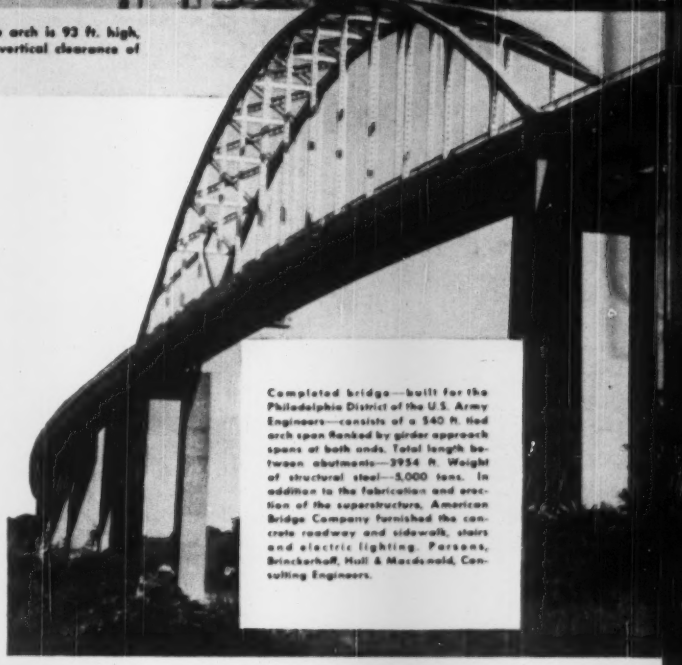
(Continued on page 86)

Dual erection methods solve arch construction problem

Erection of arch span, showing falsework and toggle bent. The arch is 93 ft. high, centerline rib to centerline of tie at mid-span, and provides a vertical clearance of 135 ft. at mean high water.

• In erecting the new highway bridge over the Chesapeake and Delaware Canal at Chesapeake City, Md., the problem was to provide a safe channel for navigation during erection. Therefore only one falsework bent could be used. American Bridge engineers solved this difficulty by an unusual combination of erection methods, using a falsework bent at the south side of the canal and a toggle bent over the north pier.

This engineering know-how — this wide experience in successfully meeting special situations on jobs of every size and type—is available to you on your own jobs, large or small, through our nearest Contracting Office.



Completed bridge—built for the Philadelphia District of the U.S. Army Engineers—consists of a 540 ft. tied arch span flanked by girder approach spans at both ends. Total length between abutments—3954 ft. Weight of structural steel—5,000 tons. In addition to the fabrication and erection of the superstructure, American Bridge Company furnished the concrete roadway and sidewalk, stairs and electric lighting. Parsons, Brinckerhoff, Hall & Macdonald, Consulting Engineers.

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21 Smart ideas

ONLY FORD GIVES YOU A CHOICE OF V-8 OR SIX

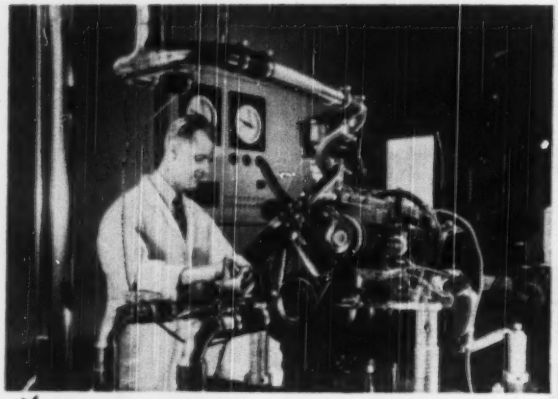
The Ford Truck line for 1950 gives you new models, new ratings, new power, new features—21 smart ideas in all, to help cut trucking costs.

NEW MODELS like the F-3 Parcel Delivery, which expand the 1950 Ford Truck line to over 175 models. This wide selection means that you should see your Ford dealer for the right truck for you, no matter what you haul. New G.V.W. rating increase on Series F-6 and F-8.

NEW POWER like the brand-new 6-cylinder Rouge 254 truck engine. Thus, for 1950 you have a choice of four great engines, two Sixes, and the only two V-8's in trucking. Only Ford gives you a choice of V-8 or Six.

NEW FEATURES like the full air brakes now available on the 1950 F-8 Big Jobs . . . single-speed axles for the F-6 and F-8 . . . new Synchro-Silent transmissions . . . new features that make driving safer and easier.

New models! New ratings! New power! New features! You'll find all these smart ideas in Ford Trucks for 1950. And you'll find the smartest idea of them all . . . Bonus Built construction which means big reserves of strength and power. That's why a 1950 Ford Truck is the smart buy for you. Your Ford Dealer can arrange quick delivery on most models. See him today!

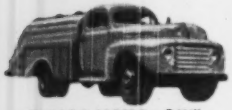


★ **NEW 110-HORSEPOWER SIX!** The new Rouge 254 makes the 1950 Ford F-6 the most powerful 6-cylinder Ford Truck ever built. The thoroughly proved 254 has Free-Turn exhaust valves, Autothermic pistons, chrome-plated top piston ring, High-Lift camshaft, and many other power-producing, cost-saving, smart ideas. ★ A brand-new, 4-speed Synchro-Silent transmission engineered for quiet operation, easy shifting and long life is standard with the new 254 engine.

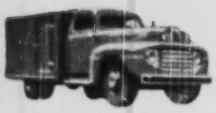
Model F-2; 5,700 lbs. G.V.W. Express or Stake

Model F-1; 4,700 lbs. G.V.W. Panel, Pickup or Stake

Model F-3; 6,800 lbs. G.V.W. Express or Stake



Model F-5; 14,000 lbs. G.V.W. Wheelbases; 134, 158 and 176 in.



Model F-4; 10,000 lbs. G.V.W. with Duals

Model F-3 Parcel Delivery Wheelbases; 104 and 122 in.

America's No. 1 Truck Value!

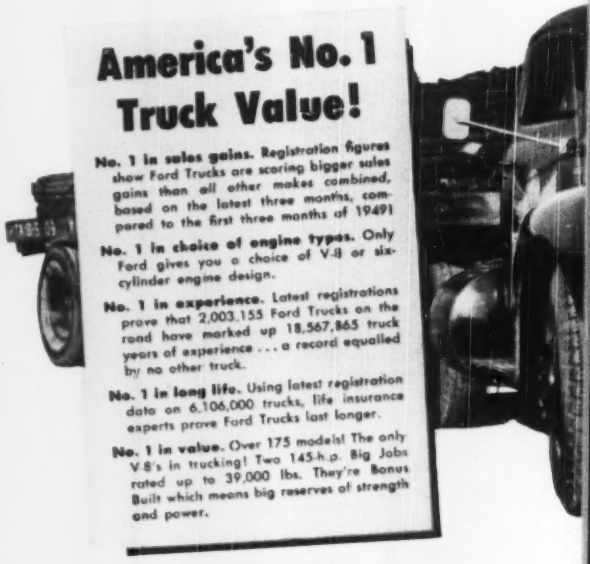
No. 1 in sales gains. Registration figures show Ford Trucks are scoring bigger sales gains than all other makes combined, based on the latest three months, compared to the first three months of 1949!

No. 1 in choice of engine types. Only Ford gives you a choice of V-8 or six-cylinder engine design.

No. 1 in experience. Latest registrations prove that 2,003,155 Ford Trucks on the road have marked up 18,567,865 truck years of experience . . . a record equalled by no other truck.

No. 1 in long life. Using latest registration data on 6,106,000 trucks, life insurance experts prove Ford Trucks last longer.

No. 1 in value. Over 175 models! The only V-8's in trucking! Two 145-h.p. Big Jobs rated up to 39,000 lbs. They're Bonus Built which means big reserves of strength and power.

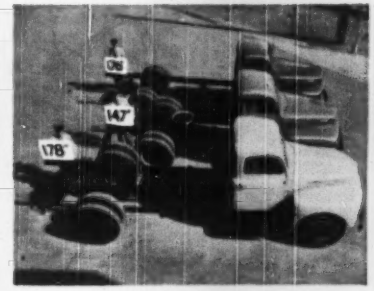


Ford Trucks Cost Less Because—

for 1950!*

—IN A FULL LINE OF OVER 175 TRUCK MODELS!

★ **NEW F-7 REAR BRAKES!** Big 15" x 5" hydraulic, dual cylinder. High torque self-centering action both forward and reverse.

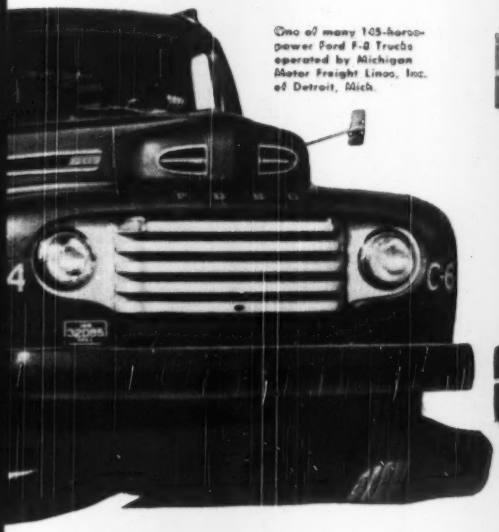


★ **NEW WHEELBASES!** Three of them for 1950 Ford Trucks. Series F-5 and F-6 now have a 176-in. wheelbase for bodies in the 15-ft. range. The 145-horsepower Ford Big Jobs have added two new wheelbases to get a total of five. First, a 147-in. wheelbase for tractors and dump trucks. Second, a 178-in. wheelbase for 15-ft. bodies.

★ **NEW PARCEL DELIVERY!** Forward control chassis with grille, windshield and quarter-windows. You add your choice of bodies. Available in Series F-3 and F-5 (Special order).

★ **NEW AIR BRAKES** available on the Ford Series F-8 Big Job combine smooth flexibility with immediate, positive action.

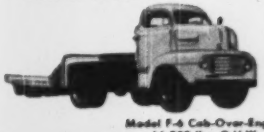
★ **New single-speed rear axle for F-8** ★ **New extra-heavy duty clutch with 254 engine** ★ **Million Dollar Cab** ★ **Air Wing door glass ventilators** ★ **Level Action cab mounting** ★ **New Double Channel frame for Big Jobs** ★ **Gyro-Grip Clutches** ★ **New single-speed axle for F-6** ★ **Roll Action Steering** ★ **New extra H. D. drive line with 254 engine** ★ **Quadrax rear axles** ★ **4 engines—choice of V-8 or Six** ★ **New heavy duty, 3-speed Synchro-Silent transmission available for F-1 thru F-3** ★ **Choice of over 175 models** ★ **Bonus Built construction.**



One of many 145-horsepower Ford F-8 Trucks operated by Michigan Motor Freight Lines, Inc. of Detroit, Mich.

Model F-5 Cab-Over-Engine 14,000 lbs. G.V.W.

Model F-5 School Bus Chassis Wheelbases: 158 and 194 in.



Model F-6 Cab-Over-Engine 16,000 lbs. G.V.W.

Model F-6; 16,000 lbs. G.V.W. Wheelbases: 134, 158 and 176 in.

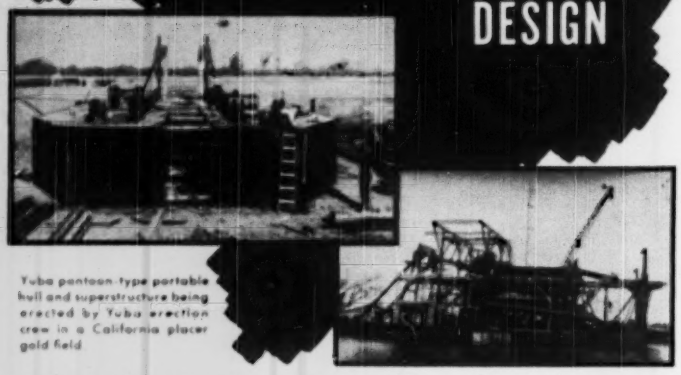
Model F-7; 19,000 lbs. G.V.W. 28,000 lbs. G.T.W.

Model F-8; 22,000 lbs. G.V.W. 39,000 lbs. G.T.W.

FORD TRUCKS LAST LONGER

Using latest registration data on 6,106,000 trucks, life insurance experts prove Ford trucks last longer!

PROFITABLE DREDGE OPERATION BEGINS WITH THE RIGHT HULL DESIGN



Yuba pontoon-type portable hull and superstructure being erected by Yuba erection crew in a California placer gold field

Consult Yuba for dependable help on design and material selection . . . wood, standard steel, portable pontoon-type.

Whether you should choose wood, steel or pontoon-type hull for your dredge, depends upon proper evaluation of many important factors, such as your operating conditions and the cost of wood compared with steel delivered at operation site. Thus the overall picture is necessary to provide a hull and structural members best adapted to the expected life of the dredge and to insure an economical installation.

Initial Design Can Provide for Changes

For a Siskiyou (California) operator, who knew he would encounter deeper gravel in a few years, Yuba designed a hull and bucket ladder which could be lengthened in the field. Recently the change-over was made, altho structural changes were anticipated several years ago, before World War II. The dredge now is working much deeper ground and without deviation from original plans.

Built for Easy Shipment and Erection

In every case, Yuba engineers consider all factors, including location and shipping facilities, when designing or rebuilding your dredge. Hulls, digging ladders, superstructure, spuds and other structural members all are built for easy shipment, even under primitive hauling conditions, and each part marked for quick field erection.

You can profit from Yuba's 40 years of continuous experience in bucket ladder dredge design and field construction. Consult Yuba NOW. No obligation; just wire or write—

Yuba will build special equipment to your order. Complete steel fabricating, forging and machine shop facilities available. Send us your blue prints or specifications for prices.

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(Continued from page 82)

Jacob Umans (M. '48) civil engineer for the New York City Board of Water Supply, died at his home in Brooklyn, N.Y., recently. Mr. Umans, who was 56, had served in several New York City engineering departments, including the Board of Transportation, the Department of Docks, and more recently the Board of Water Supply on preliminary work in connection with the Delaware and Rondout supplies. For several years he was with the Kellex Corp., of New York City, on construction of the Oak Ridge atomic bomb plant.

John Claremont Utton (M. '40) village engineer for St. Louis Park, Minn., a suburb of Minneapolis, died in a hospital in Minneapolis on December 1. Mr. Utton, who was 69, had been city engineer of Rochester, Minn., before going to Minneapolis. He was born in London and educated at the University of Minnesota. Mr. Utton belonged to the Engineers Club of Minneapolis, the American Public Works Association, and other professional organizations.

Jacob Daniel von Maur (M. '24) consulting engineer for the Consumers' Gas Co., Toronto, died at his home there on November 22. He was 77. A civil engineering graduate of Lehigh University, class of 1894, Mr. von Maur was connected with the gas industry in New York, Philadelphia, and St. Louis, prior to going to Toronto in 1924. Joining the Consumers' Gas Co. almost 25 years ago, he was recently honored at a dinner attended by 800 Canadian and United States engineers for "outstanding contribution to the science of public gas supply." He was a past-president of the Canadian Gas Association, and member of numerous other Canadian and American professional groups.

Jacob Eugene Warnock (M. '39) head of the Hydraulic Laboratory of the Bureau of Reclamation, Denver, Colo., died in a hospital there on December 26, at the age of 46. Widely recognized as an authority in the field of hydraulics, Mr. Warnock had been connected with the Bureau since 1931, and head of its Hydraulic Laboratory for most of the period since. For a number of years he served on the ASCE Hydraulic Research Committee and he represented the Society on the Engineers Council for Professional Development. Just before his death he was appointed to the Executive Committee of the Hydraulics Division. He was also active in the Colorado Section, which he had served as secretary, vice-president, and president. Mr. Warnock belonged to the International Association for Hydraulic Structures Research as well as numerous other technical and professional organizations. He was a graduate of Purdue University, class of 1925, and had been with the Army Corps of Engineers and the Aluminum Company of America before going to the Bureau of Reclamation.

Jacob E. Warnock

New Publications

Snow Removal. Findings of a committee of the Engineering Society of Detroit on the use of salt for removing snow and ice from streets and its effect on pavements, structures, and automobiles, published in the January issue of the organization's journal, *The Foundation*, is now available in reprint form. Inquiries should be addressed to the Engineering Society of Detroit, 100 Farnsworth Avenue, Detroit 2, Mich.

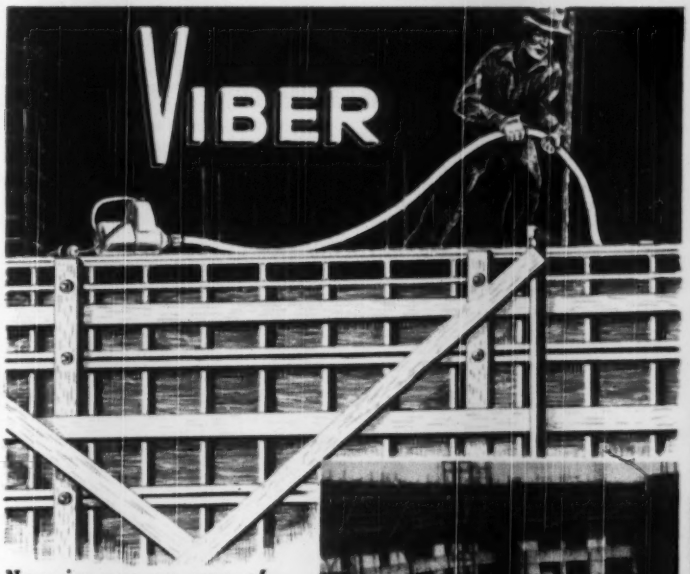
Steel Columns. Theoretical and experimental work on the subject of analysis and design of columns and other compression members done since 1921 is reviewed by A. A. Jakkula, M. ASCE, and Henson K. Stephenson, M. ASCE, of the civil engineering department at Texas A. & M. College, in Bulletin No. 91 of the Texas Engineering Experiment Station. The 118-page publication includes a bibliography of column studies and tests through 1947, and a description and summary of selected column tests published through 1947. Inquiries should be addressed to the Texas Engineering Experiment Station, the Texas A. & M. College System, College Station, Tex.

Reinforced Concrete. A comprehensive review of recent literature on prestressing and precasting of concrete and possible applications to bridge construction has been issued as Bibliography No. 7 of the Highway Research Board. The 110-page compilation was made by the Bridge Department of the California Division of Highways in an attempt to determine definitely the possibilities and limitations of precasting and prestressing of reinforced concrete structural members. The compilation was under the direction of Robert M. Barton, Jun. ASCE, assistant bridge engineer for the department. Inquiries should be addressed to the Highway Research Board, 2101 Constitution Avenue, Washington, D.C.

Traffic Safety. To aid developers, subdividers, platting officials, and planners in providing, from the traffic standpoint, safer and more desirable residential subdivisions, the National Committee for Traffic Safety has issued a 40-page illustrated bulletin reporting the findings of its Committee on Real Estate Subdivisions in the field. Copies of the publication, which is entitled *Building Traffic Safety into Residential Developments*, sell for $1 each, upon application to the National Committee for Traffic Safety, 20 North Wacker Drive, Chicago 6, Ill. A price reduction is available to National Committee organizations making quantity purchases.

River Development. Possibilities for storage regulation and power development of the lower Trinity River in California, are discussed in a manuscript report prepared by Frederick A. Johnson, Assoc. M. ASCE, hydraulic engineer of the U.S. Geological Survey, according to an announcement by Director W. E. Wrather. Manuscript copies are available for study at the Geological Survey, 1452 Del Paso Boulevard, North Sacramento, Calif.; 702 Appraiser Building, San Francisco; and in the General Services Building, Washington, D.C.

(*Continued on page 88*)



Now in use on one of the largest architectural concrete construction jobs in the United States

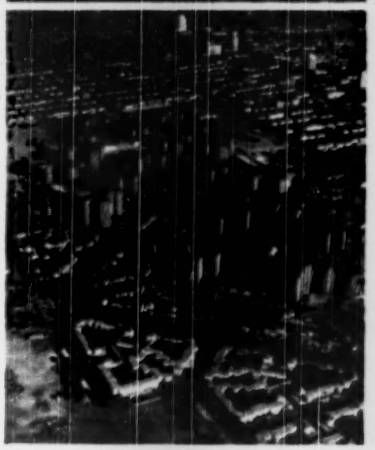
New architectural and engineering techniques are being pioneered on the Metropolitan (Parklabrea) Housing Project in Los Angeles.

VIBER SELECTED...One of the five unusual features of this tremendous project is an effort to reduce time, effort and costs in concrete placement operations. The exclusive use of Viber equipment on a project that is testing new construction methods and techniques illustrates the regard engineers and construction men have for this interchangeable line of concrete vibrators.

VIBER RUBBER TIPS...Viber's development of rubber tips has reduced damage to expensive forms....an important phase of architectural construction costs.

GOVERNMENT AND RESIDENTIAL HOUSING...The vast program of Government and residential housing now in planning and process is just one of the fields in which Viber plays an important roll.

For further information on the complete line of Viber Interchangeable Vibrators, please wire or write



$40,000,000 Parklabrea Housing Project, Los Angeles

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Dept. 18, 726 South Flower Street, Burbank, California.

(Continued from page 87)

Missouri Basin Development. The revised six-year program, adopted by the Missouri Basin Inter-Agency Committee at its recent meeting in Powell, Wyo., is now available from the Office of the Division Engineer of the Missouri River Division at Omaha, Nebr. Expenditures and estimated requirements for the six-year period, 1951-1956, are included in the 52-page report, which represents the third annual revision of the Missouri River Basin Development Plan.

Water Resources. Continuing its program of surveying the causes and effects of local floods and assembling the data in annual bulletins, the Ohio Water Resources Board has issued an illustrated study entitled *Local Floods in Ohio During 1948*. The report, designated Bulletin 18, was prepared in cooperation with the Water Resources Division of the U.S. Geological Survey. Author of the report is William P. Cross, M. ASCE, hydraulic engineer for the Geological Survey. Inquiries regarding Bulletin 18 should be addressed to the Ohio Water Resources Board, Columbus, Ohio.

Bridge Stability. An investigation of the aerodynamic stability of suspension bridges, with special reference to the Tacoma-Narrows Bridge, is reported in Part I of Bulletin No. 116 of the University of Washington Engineering Experiment Station. These studies, made prior to October 1941, were conducted by the Structural Research Laboratory of the University of Washington under the direction of the Washington Toll Bridge Authority in cooperation with the Public Roads Administration. Prof. F. B. Farquharson, M. ASCE, is the author of the 143-page illustrated report. Tacoma-Narrows Bridge investigations subsequent to October 1941 will be reported in later sections of Bulletin No. 116. To obtain Part I write the University of Washington Engineering Experiment Station, Seattle, Wash.

United Nations. To clarify reference to the various committees and agencies of the United Nations, the U.N. Department of Public Information has issued a 222-page *Handbook of the United Nations and the Specialized Agencies*. Copies are available at $1 each from the Department of Public Information, United Nations, Lake Success, N.Y.

Oil Research. Salient statistics showing the development of the oil industry, and the expanding use of petroleum as a source of energy for light, heat, power, transportation, and mechanization in the past 30 years are made available in a compendium of the Oil Industry Information Committee, entitled *Petroleum Industry Record, 1918-1948*. Copies may be purchased from J. A. McNally, American Petroleum Institute, 50 West 50th Street, New York 20, N.Y., at 50 cents each. Discounts are available for bulk orders.

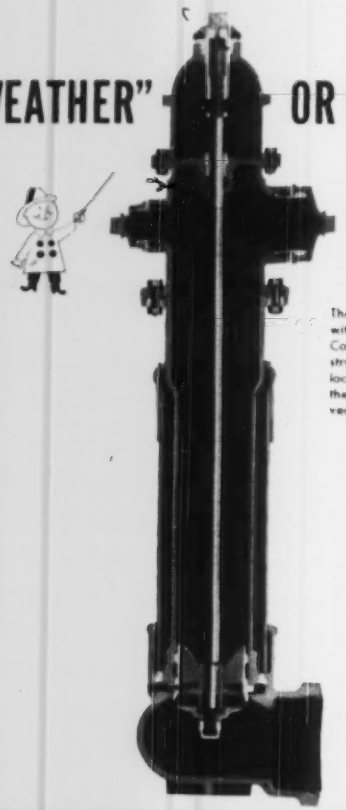
City Planning. Zoning laws and ordinances are brought up to date by Charles and Arden Rathkopf, members of the New York Bar, in a second edition of *The Law of Zoning and Planning*. This 667-page practical reference work for town, village and county attorneys and officials, sells for $15. Inquiries should be addressed to the Grosby Press, 30 Ferry Street, New York 7, N.Y.

Highway Research. To provide a classified listing of highway research projects in progress or recently reported on by state highway departments, federal bureaus, universities, colleges, and other agencies, the Highway Research Board has launched a quarterly publication, entitled *Highway Research Review*. This new service will attempt to summarize the over-all highway research and development program for the benefit of highway administrators and to acquaint active research workers with the parallel activities of other agencies, thus forestalling duplication of effort. Inquiries should be addressed to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

Franklin Institute. Laboratory and research facilities of the Franklin Institute are summarized in a brochure, entitled *Laboratories for Research and Development*. Founded in 1824 to carry out industrial research, the Institute provides facilities for studies of strength of materials, photoelasticity, aeronautics, measurement and control, radiation, metallurgy, and many other fields. Copies of the brochure may be obtained by writing to the Administration Division, the Franklin Institute Laboratories for Research and Development, Benjamin Franklin Parkway at 20th Street, Philadelphia 3, Pa.

(Continued on page 91)

"WEATHER" OR NOT



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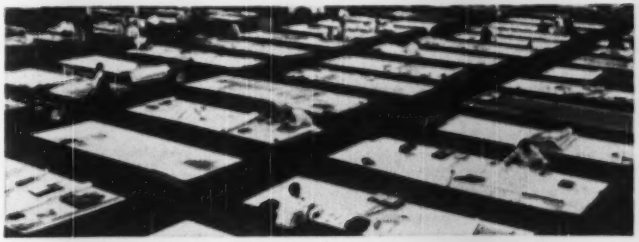

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Men Available

GRADUATE ENGINEER, M. ASCE, 25 years structural design experience in industrial and commercial buildings, municipal incinerators, aqueducts and subways. Licensed. Desires position in New York City. C-555

CIVIL ENGINEER, Jun. ASCE, married veteran, B.S. in C.E. January 1949. Desires position in field or office doing structures, hydraulics, or soil mechanics. Willing to travel; available immediately. C-556

CIVIL STRUCTURAL ENGINEER, Assoc. M. ASCE, 37, married, sober, a conscientious worker. 13 years experience, planning structural design and supervision, commercial, industrial and institutional buildings, tunnels, hydraulic structures and refineries. Seeks position of responsibility, resident engineer, administrative or construction superintendent. C-557

ENGINEER, Jun. ASCE, ASME, registered professional engineer. Production and plant engineering, design chemical process equipment, tablet presses, welded steel plate construction and ceramic equipment. Desires position as assistant chief engineer, chief draftsman or salesman in Philadelphia area. C-558

JUNIOR ENGINEER, Jun. ASCE, B.S. 1949, married, veteran, 4 months experience airport engineering, 6 months experience city planning surveys, desires employment with established *engineering firm, interested in highway, airport*, or municipal engineering, field or office work, domestic or foreign service optional, available immediately. C-559

CIVIL ENGINEER, Jun. ASCE, 31, married, B.S. in C.E., graduate work in Geodetic Surveying. 8 years widely diversified experience on large construction projects, chief field engineer on large bridge project recently, construction superintendent in charge of construction of a water supply and distribution system for town in a Latin-American country. Desires supervisory position in engineering or construction. C-560

CIVIL ENGINEER, Assoc. M. ASCE, professional engineer license W. Va. and Ky., graduate engineer, 43, married, 18 years experience heavy construction railroads, presently employed with large eastern railroad but would like to enter another field in which my experience is of benefit, will consider any location in United States. Available 2 weeks notice. C-561

CIVIL ENGINEER, Assoc. M. ASCE, professional engineer N. Y. State, B.S., M.S. in C.E., 30, married, 8 years varied experiences in hydraulic and sanitary engineering, including 3 years consulting work in responsible capacity with top-level experience in land development, sanitary investigations, preparation of reports, cost estimating, design, and contacts with industrial and municipal officials. C-562

Positions Available

ENGINEERS. (a) Architect, graduate, with substantial experience in layout work and architectural design of industrial buildings and capable of carrying out assignments with a minimum of supervision. (b) Structural Designer, civil graduate with considerable experience in the design of structural steel and reinforced concrete structures, to design and layout industrial buildings. Salaries open. Location, Massachusetts. Y-2720

ASSISTANT OR ASSOCIATE PROFESSOR, preferably with advanced degree to teach fluid mechanics, advanced course in hydraulic engineering and assist with research program in hydraulic engineering. Salary, $5,500-$6,400 for 9 months. Opportunity for summer teaching or outside work. Location, South. Y-2823

RECENT, under 30, graduate civil engineer with some experience on school publication or preferably with from 1 to 3 years experience on construction. Salary, $3,600 a year. Location, New York, N.Y. Y-2923

SANITARY ENGINEER. (a) Sanitary Engineer, graduate with 10 to 15 years experience in water distribution and sewerage systems, waterworks and sewage treatment plants, dams, reservoirs, etc. for consulting engineering firm. Must have construction experience, thorough knowledge of sanitary design and be capable of directing drafting room work. Salary dependent on qualifications. (b) Sanitary Engineer, graduate, with 3 to 5 years experience in sewage systems, waterworks, etc. to direct work of small squad of draftsmen and/or junior engineers in sanitary design. Salary dependent on qualifications. Location, Pennsylvania. Y-2936

SALES AND CONTRACT ENGINEER, 30-45, civil graduate. Must have had some experience on structural steel, preferably bridge work. Some previous sales experience desirable. Salary, $4,000-$5,000 a year. Location, eastern Pennsylvania. Y-2939

CIVIL ENGINEER, graduate, with at least 12 years experience, to supervise project engineers on building work, waste disposal and structural design, for chemical company located in the East. Scheduling experience also desirable. Write stating experience, education, and salary requirements. Y-2970

PROFESSOR in sanitary engineering, with advanced degrees, to develop sanitary engineering program and to head department of civil engineering. Experience in engineering practice and in research essential. Location, East. Y-3007

ASSISTANT ENGINEER, 30-40, civil graduate, with at least 5 years experience in municipal design construction and maintenance, to assist resident engineer and manager in charge of utility construction program consisting of telephone system, power plant, water-treatment plant, steam, electric and water distribution systems. Salary $7,000-$10,000 a year. Location, Alaska. Y-3018(S)

TEACHING PERSONNEL. (a) Instructor with B.S. degree in civil engineering, with at least 2 years experience in the construction field. (b) Instructor B.S. degree and 2 years experience in steel fabrication. Salary $3,277 a year. Location, Brooklyn, N.Y. Y-3127

CIVIL ENGINEER, 40-50, to head and coordinate a large construction program in South America. Must have from 10 to 15 years experience in the design, planning and supervision of a large construction project. Some experience in foreign field desirable. Salary $25,000-$35,000 a year. Headquarters, New York, N.Y. Y-3152

CIVIL ENGINEER, 30-45, experienced in the design and construction of sewer and water systems, street improvements, and other municipal improvements. Must be free to travel. Salary, about $7,000 a year. Headquarters, St. Louis, Mo. Y-3160

PLANT ENGINEER, (maintenance and construction) M.E. background, in early 40's, well-seasoned background in food handling or products where sanitation is an element, requires knowledge of tanks, piping, refrigeration, heat exchange, construction methods, installation, modification of major plant equipment and facilities, and construction. Position 90 percent supervisory for a brewery. Salary, $7,000-$8,000 a year. Location, Midwest. R-6136

TECHNICAL WRITER, civil engineering graduate, 25-35, experienced in field and office work to assist in preparing sales promotional matter for manufacturer of engineering supplies. Good opportunity leading to executive work. Salary open. Location, Chicago, Ill. R-6142

FIELD ENGINEER, C.E. under 30, minimum 3 years highway engineering experience either in soils, materials control, or construction. Will involve promotion and technical service work. Will contact design and construction engineers and contractors, make field studies including soil surveys, prepare technical literature, reports, and correspondence, give talks, assist in laboratory investigations. Travel approximately half of time. Salary open. Headquarters, Chicago, Ill. R-6147

SALES ENGINEERS, 35-45, C.E. or architectural background, broad experience contacting architects, engineers, contractors, and building supply concerns. Sales and promotional work for manufacturer of building material products, i.e. refrigeration insulating materials, etc. Conduct meetings with distributors, personal contact and general service work. Territories: Cleveland, Philadelphia, Atlanta, St. Louis, San Francisco, Pittsburgh. Salary, $5,000. R-6150

ASSISTANT DIRECTOR OF ENGINEERING (construction), C.E., up to 45, substantial and broad experience with construction of all types. Will act as owner's representative and contact architectural and construction companies' representatives in connection with a large construction program. Salary, $7,600 a year. Location, Chicago, Ill. R-6156

DESIGNER, Checker Structural, graduate preferred, 8 to 10 years experience on building design of heavy buildings, power plants, structural and reinforced concrete. Must have strong technical background and be completely informed regarding all design details as encountered in a consulting engineering office. Salary up to $500 a month. Location, Chicago, Ill. R-6151(b)

STAFF ENGINEER, C.E., M.E. or architectural, 30-35, some general experience which will fit him for rendering a technical service to an association, its clients and suppliers. Should have knowledge of steel, wooden structures, building codes, and be informed regarding architectural and mechanical requirements. Should be able to design and redesign functional structures complying with code, appearance, economy, and ease of operation limitations. Will require information on illumination, metallurgy, chemistry, and soil mechanics. Must be able to speak in public, be competent to advise and to conduct technical supervision in the field with sales representatives, and maintain good public relations. Will ultimately be licensed as a structural and/or professional engineer for a national trade association. Salary, $4,500-$7,500 a year. Travel. Headquarters, Chicago, Ill. R-6157

ESTIMATOR, under 50, fully experienced and qualified to prepare estimates on public industrial and commercial buildings up to $750,000 for a building company. Salary open. Location, Kansas. R-6164

ASSISTANT DIRECTOR OF CONSTRUCTION ENGINEERING, extensive experience at substantial levels with problems and planning techniques from a technical and administrative standpoint for a large construction program handled by contractors. Will be required to make inspections, coordinate contractors' work, initiate important correspondence, compile reports, prepare and review contract matters, review and analyze progress reports, cost budgets and expenditures, assume responsibility for planning, supervising and coordinating all engineering activities for a government engineering division. Salary, $7,600-$8,600 a year. Location, Illinois. R-6165

DESIGNER, structural; well experienced construction of steel and reinforced concrete. Salary open. Location, Ohio. R-6167(c)

DRAFTSMAN-DESIGNER (electrical) minimum 3 years experience with structural drafting, knowledge of handbooks and other engineering source references, informed about standard sizes and structural members selection. Work on drafting board, later at engineering desk in the engineering department of a large food processing plant. Salary, approximately $80 a week. Location, Michigan. R-6172

Meetings and Conferences

American Concrete Pipe Association. Headquarters of the 42nd annual convention of the American Concrete Pipe Association will be the Fairmont Hotel, San Francisco, Calif. The dates are February 22–25.

American Institute of Mining and Metallurgical Engineers. Technical sessions, inspection trips, and social events of the annual meeting of the American Institute of Mining and Metallurgical Engineers are scheduled for the Statler Hotel, New York, N.Y., February 12–16.

American Road Builders' Association. The annual meeting of the American Road Builders' Association (including the airport division conference) will take place at the Netherlands Plaza Hotel, Cincinnati, Ohio, March 6–9.

American Society for Testing Materials. Headquarters for the American Society for Testing Materials meeting will be the William Penn Hotel, Pittsburgh, Pa., February 27–March 2.

Institution of Electrical Engineers. Electric railway traction is to be the theme of the conference of the Institution of Electrical Engineers at the Institution Building in London, England, March 20 through 23.

Minnesota Federation of Engineering Societies. New equipment in all fields of engineering will be displayed at the Fifth Annual Engineering Exposition of the Minnesota Federation of Engineering Societies, at the Minneapolis Armory, Minneapolis, February 21–24.

Builders View Problems of Constructing UN Headquarters

(*Continued from page 48*)

am sorry to say that owing to a failure of a piece of machinery we had a rather bad accident on the foundations.

Because of all the problems that have arisen both from an engineering and construction standpoint and the necessity of keeping it within the amounts of money available for the project, there has been exceptionally close contact between the owner, designers, engineers, subcontractors, workmen and ourselves. Everyone has cooperated all along the line. It has been an extremely interesting and pleasant experience. The result is that the building is in my opinion not only better than it would have been without such cooperation but also it is nearly 70 percent completed and I am sure will be entirely completed long before our scheduled time.

New Publications

(*Continued from page 88*)

Modular Coordination. In a recent booklet entitled *Modular Coordination*, the Housing and Home Finance Agency explains the importance of standardization of building materials on a uniform basis of measurement in keeping building costs down. Also included is an illustrated section on how the system works. The 20-page booklet may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 15 cents.

Traffic Safety. Many promotional ideas for spreading propaganda on traffic-accident prevention and for conducting successful safety campaigns have been assembled by the National Association of Automotive Mutual Insurance Companies under the title of *Here's How—to Combat Traffic Accidents with Safety Projects*. Free copies are available from the Association, 919 North Michigan Avenue, Chicago 11, Ill.

Prestressed Concrete. An American edition of *Principles and Practice of Prestressed Concrete* by P. W. Abeles (reviewed in the October issue) has been made available by the Frederick Ungar Publishing Co., 105 East 24th Street, New York 10, N.Y., at a cost of $3.75. In the American edition, all notations have been adapted to American standards, and there are two new appendixes and a preface by D. B. Steinman, M. ASCE.

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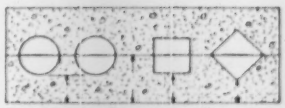

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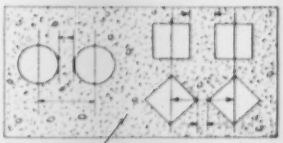

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Engineers Build 500-Mgd Water System for Sunbury Station

(Continued from page 29)

standby. The two pumps connect to separate discharge lines, so that each sump has two discharge lines, each served by a pump. Thus half of the ash disposal system at each sump can be shut down and the other half will be capable of handling the full load of the unit.

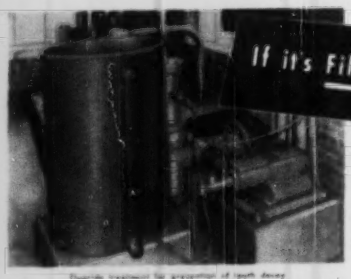
A 3-in. raw-water line is installed parallel to the 8-in. ash transfer lines, with taps so arranged in both lines that if an ash line becomes plugged, a hose connection can be made from the 3-in. line to locate and possibly clear the stoppage.

Two large disposal areas are available south of the operating area for ash storage. After the ash-laden water is discharged in the disposal area, the next problem is to separate the ash from the water, since water discharged back into the Susquehanna River must be of a quality satisfactory to the State Sanitary Water Board.

As it is expected that approximately 90 percent of the ash from the plant will be flue dust, laboratory tests were made in order to determine just how this ash would settle out. A complete analysis was made of the water both before mixing and when withdrawn from the mixture after settling. A report of the results of this analysis accompanied the application to the Commonwealth for a permit to return the ash sluice water to the Susquehanna River, and on the basis of this report the Sanitary Water Board granted the desired permit.

Settlement of Ash-Water Provided

To meet the requirements of the Commonwealth, a pool will be maintained in the ash storage areas to allow sufficient time for settlement of the suspended matter before the water is returned to the river. To accomplish this aim a concrete outlet structure is provided at the southerly end of the first ash-water disposal area. This structure is designed so that any pool elevation can be maintained by means of stop logs, over which the water is discharged. The water then passes through a 36-in.-dia pipe culvert in the dike surrounding the ash storage area and discharges into the Susquehanna River. In order to keep surface scum from discharging into the river, a skimmer gate is provided in the discharge structure. This gate is movable and can be so adjusted that at any pool elevation the water will pass under the gate and over the stop-logs.



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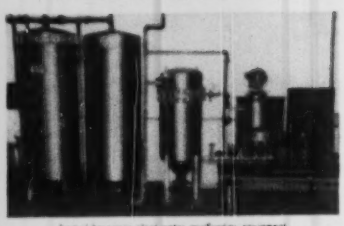

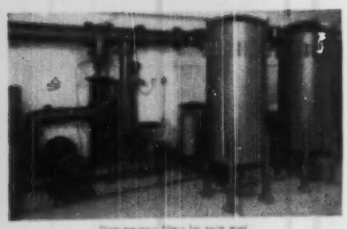

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Navigation Lock Leading Into New Orleans Harbor

(Continued from page 35)

and work under that contract should be completed late in 1950. The operating machinery will be installed under a subsequent contract and should be completed soon after the gates have been installed. Other items of work on the project—bridges, canals, pumping plants, roads and levees—will be prosecuted under several separate contracts during the next two or three years.

The Algiers Lock and Canal is scheduled for completion in 1952 at an estimated cost of $13,000,000. The project is being designed and built by the Corps of Engineers, U.S. Army, from its New Orleans District Office. The Chief of Engineers is Maj. Gen. Lewis A. Pick, Washington, D.C., and the District Engineer at New Orleans is Col. Charles G. Holle. The writer, as chief of the Engineering Division of the New Orleans District, has been in charge of the design of the Algiers Lock since May 1948.

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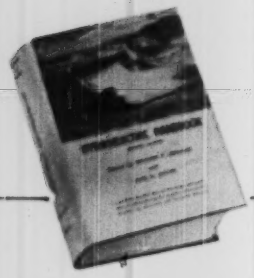

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- Section III: Conduits and Powerhouses
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Recent BOOKS

APPLIED HYDROLOGY. By R. K. Linsley, M. A. Kohler, and J. L. H. Paulhus. McGraw-Hill Book Co., New York, Toronto, London, 1949. 689 pp., illus., diagrs., charts, maps, tables, 9½ × 6 in., cloth, $8.50. This combination text and reference book deals with the factors governing the movement of water in all its phases through the hydrologic cycle. Emphasis is given to fundamental relations and to the development of practical techniques for computing and forecasting streamflow, evaporation, snowmelt, etc. The application of these techniques to the solution of flood control, irrigation, drainage, and related problems is discussed in detail. Basic data, techniques, and problems are mainly characteristic of hydrology in the United States.

APPLIED MECHANICS. 5 ed. By A. P. Poorman. McGraw-Hill Book Co., New York, 1949. 388 pp., diagrs., charts, tables, 8½ × 5½ in., cloth, $4. This standard work on applied mechanics has been revised and brought up to date in this fifth edition. The law of Coriolis and a table of moments of inertia and radii of gyration of a number of simple areas are among the additions made. Loads on structures are now given in kips. The data of all problems are changed, and new problems are added. As in previous editions, answers to all problems are given.

ELEMENTARY STRESS ANALYSIS. By P. E. Soneson. Pitman Publishing Corp., New York, Toronto, London, 1949. 351 pp., illus., diagrs., charts, tables, 9½ × 6¼ in., linen, $5. Intended as a text for courses in the analysis of statically determinate structures, this book applies the fundamentals of mechanics to the computation of the stresses in simple frameworks. Actual roof and bridge structures have been freely used as illustrative examples. Certain special topics, such as wind forces and moving loads, are taken into consideration. Excerpts from American Railway Engineering Association and American Association of State Highway Officials specifications are included as well as material from other professional sources.

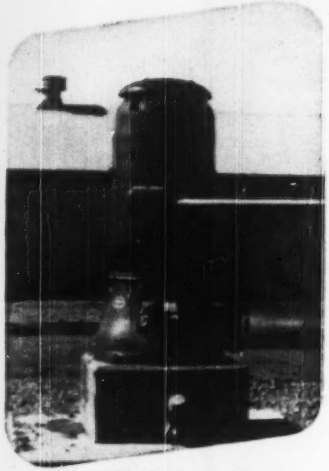
Books in the Engineering Societies Library may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains research and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

THE HEAT PUMP. ITS PRACTICAL APPLICATION. By J. B. Pinkerton. Princes Press Ltd., 147 Victoria St., Westminster, London, S.W.1, 1949. 257 pp., illus., diagrs., charts, tables, 9½ × 6½ in., cloth, 25s. Based on a series of articles in *Air Treatment Engineer*, this book is written for the engineer who is concerned with the design, installation, or maintenance of heat pump installations. Following the section on theory, practical applications are considered. The third and last section deals with the development of atomic energy as a fuel. A bibliography is included.

METHODS OF JOINING PIPE. By J. E. York. Industrial Press, New York, 1949. 236 pp., diagrs., tables, 8½ × 5½ in., fabrikoid, $3; to foreign countries, $3.40. Illustrates and describes all types of pipe joints, including expansion joints, for different classes of metallic and nonmetallic piping, with discussion of their advantages and disadvantages. The proper selection of pipe joints, based on consideration of influencing factors, is also covered.

NON-LINEAR PROBLEMS IN MECHANICS OF CONTINUA. Proceedings of Symposia in Applied

(Continued on page 96)



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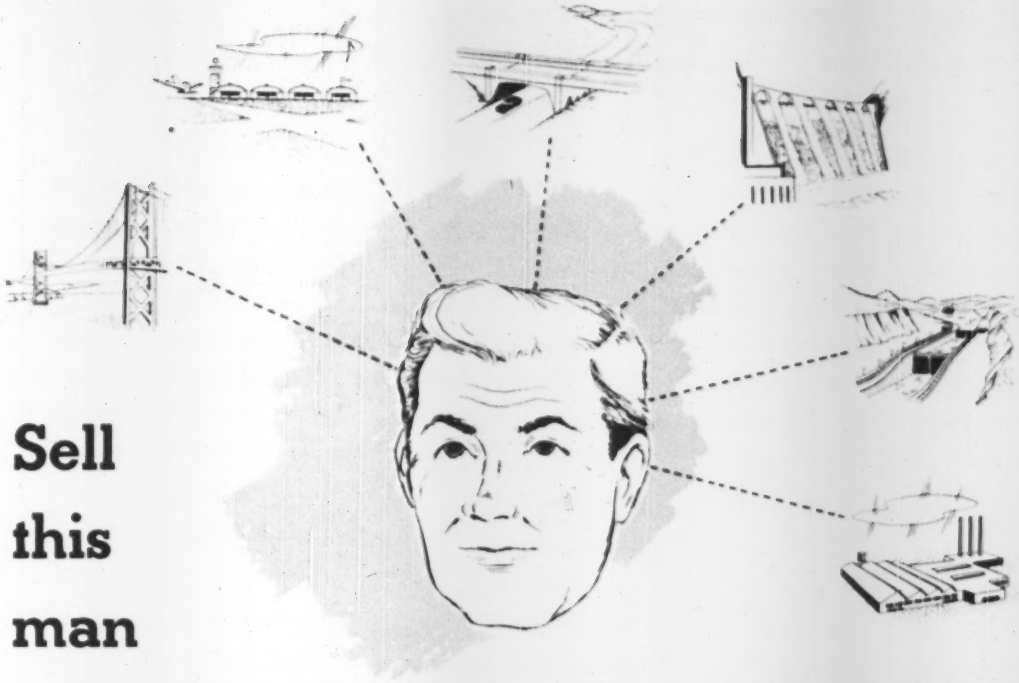

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Breakdown by TITLE of readers of

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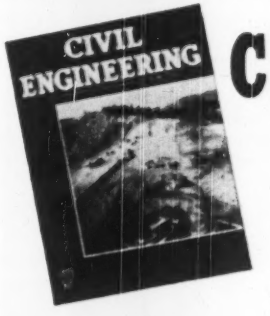
(Based on May '49 issue)

Owners and Corporate Executives	4,130
General Managers and Managers	2,185
Chief Engineers	1,695
Project and Staff Engineers	10,060
Designers and Registered Staff Architects	643
Draftsmen	389
Superintendents of Construction (Supervisory Staffs)	626
Other Department Managers and Heads	291
Individuals and Other Employees	5,705
	25,724

*AVERAGE TOTAL NET PAID (Exclud. Bulk) 1st six months 1949 27,068



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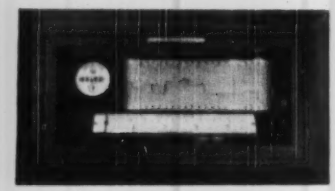

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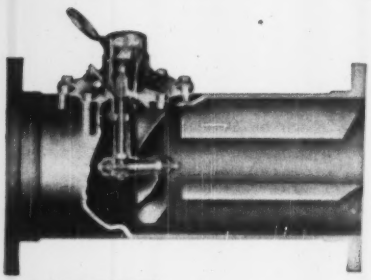

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(Continued from page 94)

Mathematics, Volume II. Published by the American Mathematical Society, 531 West 116th St., New York, 1949. 219 pp., diagrs., charts, tables, 10¼ × 7 in., cloth, $5.25. This volume contains papers presented at the First Symposium on Applied Mathematics, 1947, of the American Mathematical Society. The papers have been subdivided into two groups. One concerned with the field of hydrodynamics and aerodynamics; the other including results in electricity and plasticity. A few of the papers presented at the symposium were published elsewhere, and of these comprehensive abstracts are given.

•

Aggradation in Rio Grande Affects Sedimentation of Elephant Butte Reservoir

(*Continued from page 51*)

mouth of Santa Fe Creek, to Elephant Butte Reservoir, a distance of 133 miles, is about as follows:

Average sediments deposited on valley floor between Cochiti and San Marcial, 1936–1941,* in acre-ft per year	11,560
Average sediments accumulated in Elephant Butte Reservoir 1915–1947,† in acre-ft per year	14,370
Total sediments contributed between Cochiti and Elephant Butte Dam	25,930
Drainage area between Cochiti‡ and Elephant Butte Dam,† in sq miles (25,920 – 11,660)	14,260
Average sediment deposited, in acre-ft per sq mile per year	1.8
Tons per sq mile per year at specific weight of 65 lb per cu ft (1.470 tons per acre-ft)	2,550

* *Sedimentation in Middle Rio Grande Valley*, Hopp.

† *Sedimentation Surveys of Elephant Butte Reservoir*, U.S.B.R., February 1949.

‡ *Rio Grande Joint Investigations*, February 1938, National Resources Planning Board.

Future of the Reservoir

The Bureau's data indicate that the reduction in storage capacity in the reservoir has been materially diminished in recent years:

Period	Loss of Storage Capacity per Year	Loss of Original Capacity per Year, %
1915–1935	18,000 acre-ft	= 0.68
1935–1947	6,020 acre-ft	= 0.23
1915–1947	13,520 acre-ft	= 0.51

It is obvious that the Rio Grande sediments which in earlier years went into the reservoir are now being deposited on the valley floor above the reservoir—that is, the main valley is being aggraded, a process doubtless due to erosion of sedimentary deposits on the tributaries. These periods of aggradation and degradation are one of the geologic phenomena of the Southwest.

The process of aggrading cannot continue forever. Ultimately there will come a time in the history of the Rio Grande valley when a period of deggradation will set in. When that time comes, and in spite of all that man can do, the sediments now accumulating on the valley floor will be dug into by the Rio Grande in ever-widening channels and carried willy-nilly into Elephant Butte Reservoir.

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Pictured here is a "Caterpillar" No. 80 Scraper rated at 18 heaped yards with its matching D8. Owned by Eau Claire County, Wisconsin, this team pays dividends every pay load. Making a trip every 7½ minutes on an 1800-foot round-trip haul, its average production is about 800 bank measure cubic yards per 8-hour day.

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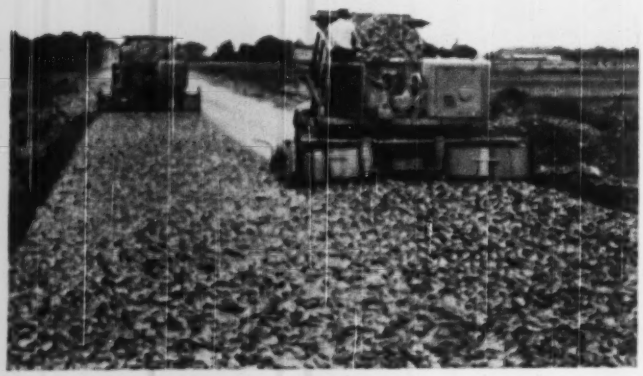
EQUIPMENT, MATERIALS *and Methods*

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Aggregate Spreader

A SELF PROPELLED AGGREGATE spreader said to be the first machine of its kind which accurately lays all base and surface aggregates, free-flowing bituminous mixtures and plant-mixed stabilized soils, has been announced. Costing less than half as much as standard bituminous pavers, the machine has many unusual design and mechanical features for accuracy, speed and flexibility of operation. Powerful four-wheel drive is always on the subgrade or rolled course, never on the newly laid material. Thus, there is no displacement or disturbance of the laid aggregate to cause irregularities, uneven compaction and later costly repairs. The machine lays any size of aggregate up to 4-in. stone, in thicknesses up to 10 in., with positive accuracy. Its strike off screed is carried by long straightedge runners which glide smoothly on the subgrade despite any up and down motion of the wheels and machine itself. These runners average out irregularities of the subgrade while the closely-adjustable screed produces a uniformly smooth and accurate surface. Screed is quickly and easily adjusted from the top by handcrank for any desired thickness of material, crown, wedge, or leveling course. The two-ton hopper easily accommodates material from any size truck. lays it as fast as trucks can deliver. Automotive transmission and powerful Continental gasoline engine offer 12 to 100-fpm forward speeds and $^1/_2$ to $3^1/_2$ mph reverse speeds. The unit is self-transporting. A hydraulic ram lifts screed and runners up to 5 in. for quick backing and maneuvering. Bulletin SPS-9, fully illustrated, is available upon request to **The Jaeger Machine Co., Columbus 15, Ohio.**



Accurately Lays All Base and Surface Aggregates

Trucks

THE NEW 1950 Ford truck line, more than 175 models, are now being displayed by Ford dealers in all parts of the country. Featured in the model trucks are 21 engineering, design and manufacturing advancements contributing to more efficient, economical performance and lower maintenance costs. Special attention has been paid to engineering improvements contributing to longer life. The models are powered by the 226 cu. in., 95-hp six cylinder Ford truck engine, the 239 cu. in. 100 hp V-8, the 337 cu. in. 145 hp V-8 and a recently developed 254 cu. in. 110 hp six. A four-speed synchro-silent transmission that eliminates double clutching is standard equipment on the 254 and an extra heavy duty clutch is included. Outstanding features of the models include 15 x 5-in. rear brakes with aluminum shoes on F-7 models. All models have spacious cabs providing living room comfort for the safety and convenience of drivers. A hypoid single-speed rear axle is offered for F-6 series and all models have the gyro-grip clutch, roll action steering and sturdy quadrax rear axles. The F-7 and F-8 series have a double channel frame for adequate support of the heaviest loads. A new heavy duty three-speed synchro-silent transmission is optional for series F-1 through F-3. Gross vehicle weight ratings for the 1950 line range from 4,700 lb in the F-1 to 22,000 lb in the F-8 straight truck and 39,000 lb when used with tractor and trailer. Full air brakes of the two-shoe type are available for F-8 series models. **Ford Div., Ford Motor Co., Dearborn, Mich.**

Tile Drill

JUST AS THE BADGER is the fastest hole digging animal known to man, so the "Badger" will drill holes faster than you think possible. It's made to fit all types of fasteners; and works equally well for rawl plugs, drive-in-plugs, shields and Ackerman-Johnsons. Fits all standard electric and rotary air tools. The scientifically ground angles do the work rapidly, yet easily. The taper prevents binding and broken corners too. It's been tested for years, and in every case the Badger out-performed all competitors 4 to 1—in speed—in life and in number of holes per grind. The Badger will drill 150 to 250 holes per grind, and more than 50 grind per blade. With this drill, holes can be started in tile and other glazed surfaces, without first breaking the polished surface and it doesn't leave cracks or ragged looking holes. Never a dull blade because they are easy to regrind and replace. All you do is loosen the set screw and remove the blade. For drilling, set chuck for proper depth, chuck acts as stop gage. Available for immediate shipment in all sizes from $^1/_8$ in. dia. up, in sixteenths. Special sizes are also made. **A. E. Kliebhan & Sons, 2261 N. 63rd St., Wauwatosa 13, Wis.**

Tournapull with Blade

A BULLDOZER BLADE attached to the Model D Roadster Tournapull has been announced. The dozer blade is suspended in front of the Tournapull, cable-activated and is electrically-controlled by a switch mounted on the dash control panel. The blade has a bowl length of 6 ft $8^3/_4$ in., height of blade and bowl is $32^1/_2$ in. Its cutting edge is reversible, with hard-surfaced, replaceable tips, and can be raised 3 ft above the ground. Equipped with

Model D

bulldozer the D Roadster Tournapull Scraper can be used either as a dozer or scraper. Since all tools are on one rig, no time is consumed in changing from dozer to scraper operation, the manufacturer points out. It also can push load other D's in fleet operation, and can be roaded under its own power over the highway between scattered jobs. **R. G. LeTourneau, Inc., Pedria, Ill.**

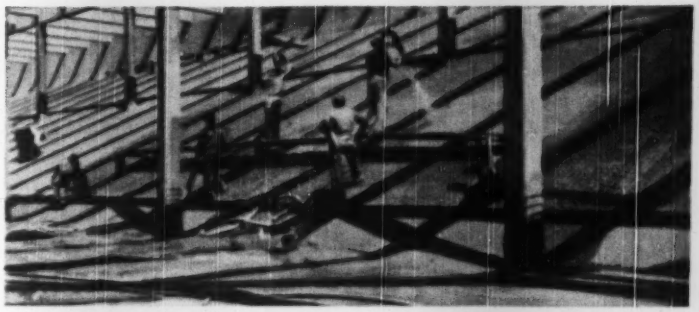
Equipment, Materials & Methods (Continued)

Air Conditioning Equipment

INTRODUCING 47 NEW PRODUCTS in its 1950 dealer line, a leading manufacturer of air conditioning and refrigeration equipment, announced this move was made in anticipation of the start of a new period of growth in the industry this year. Twenty-seven units in sizes and types not heretofore offered by the corporation, ranges from room air conditioners to System Weathermakers in capacities up to 75 tons. The latter are particularly suitable for multi-room buildings and other large establishments. Other models in the line have been completely redesigned to improve efficiency and appearance. Five of the models are System Weathermakers, which are designed for remote installation in the basement or in a room not used for commerce, which employ ducts for the circulation of conditioned air. Both floor and ceiling suspension types are available in this type of equipment, ranging in capacity from five to 75 tons. The self-contained Weathermakers for air conditioning suites of offices and other sizable spaces were increased in number from three to five models. The sizes already offered by Carrier in 3, 5 and 7½ hp capacities, have been completely restyled, and two units of larger capacity, 10 and 15 hp, have been added to the line. New features include better means of cooling and humidity control, and unusually quiet operation. Other units in this line of products include room air conditioners, cooling towers, food freezers, hermetic condensing units, belt-driven condenser units and fan and recirculating units. Carrier Corp., Syracuse, N.Y.

Truck Engine

A MORE POWERFUL 6-CYLINDER Ford truck engine with four-speed synchro-silent transmission is now available as optional equipment on series F-6 Ford trucks. Designed to provide even greater performance and acceleration for heavy hauling and high speed on grades, the Ford Rouge 254 truck six engine develops a maximum of 110 hp and 212 lb ft torque. The engine embodies many outstanding performance, economy and durability features. The truck engine is equipped with free valves having a special cap design on exhaust valve stems which permits free rotation when opening and closing for self-cleaning, better seating and longer valve life. The high lift camshaft is of heavy cast-alloy iron with large inserted type replaceable bearings, gear driven direct from the crankshaft. A precision machined aluminum timing gear assures quiet operation and longer life. The large universal joints of heavy needle roller bearing design deliver full torque with a minimum of friction. The center bearing is rubber encased, self-aligning, leakproof, dust and watertight. Ford Div., Ford Motor Co., Dearborn, Mich.



"GUNITE" LINING RESTORES RESERVOIR

When the old, open Ballou Park Reservoir at Danville, Va., was improved and covered in 1948, excessive leakage of the old brick lining was stopped with reinforced "GUNITE". The photo shows details of the process. After concrete columns to support the roof were placed, wire mesh reinforcing was laid and the entire reservoir was "GUNITED". Note that the reinforcing and "GUNITE" were carried over the column footings and up the columns approximately three feet to prevent leaking at those points.

The use of "GUNITE" for repair and construction of reservoirs, bridges, buildings, etc., is illustrated and described in Bulletin B2400. We will gladly send a copy at your request. On your letterhead, please.

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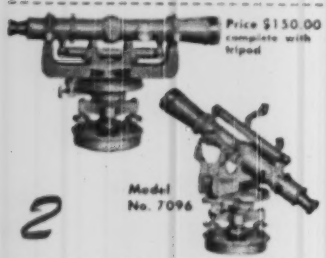

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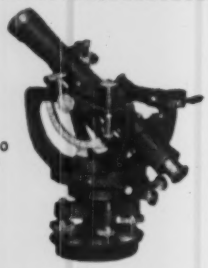

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Equipment, Materials & Methods (Continued)

Adjustable Discharge Mixer

THE REX ADJUSTABLE discharge mobilmixer . . . the horizontal drum mixer with the high discharge feature, has recently been announced. It combines the fast, thorough mixing, fast charging, fast discharging and economical operation of the horizontal mixer with the versatility of the high discharge mixer. The discharge of the mixer can be elevated to a maximum height approximately equal to any high discharge type of mixer . . . or elevated to any intermediate point in the hoist range.

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This makes for greater flexibility in getting concrete into the forms with ease and speed, by reducing spout manipulation to a minimum. Other exclusive Rex features include chain drum drive, Manten steel drum and blades, versatile spouting, enclosed water system and the non-clogging water nozzle. In addition, the mixer has fluid drive for smoother operation and protection from shock loads to motor, transmission and final drive. Advertising Dept., Chain Belt Co., 1600 W. Bruce St., Milwaukee 4, Wis.

Power Control Units

DESIGNED FOR EVERY crawler tractor and for every cable control use is a new line of power control units. The line includes 3 models, Model C-90D, double drum, for tractors of 50 hp and up; Model C-50D, double drum, for tractors up to 50 hp; and a Model C-50S, single drum, for tractors up to 50 hp. A special unit, known as the Model C-90DL, for logging and extra heavy duty work, features extra heavy duty clutch and cone, and special drum and control guards for added protection. Features include alloy, heat-treated cast steel cases and covers; heat-treated, alloy steel gears; roller or ball bearings on all turning parts; high-strength, alloy cast iron clutch and brake drums; cone-type clutch; gear ratios from 5 to 1, up to 12 to 1; swinging fairleads on models C-90D and C-50D, and adjustable control levers. Complete specifications and prices are contained in Bulletin 304-ED. Kay-Brunner Steel Products, Inc., Equipment Div., 2721 Elm St., Los Angeles 65, Calif.

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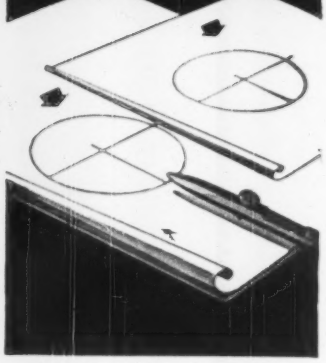

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Equipment, Materials & Methods (Continued)

Diesel Engines

TWO NEW SIX-CYLINDER, high-speed diesel engine models designed for on-highway and off-highway automotive applications have been in production. Both the HRBB-600 (highway) and HRBBI-600 (off-highway) models have a maximum rating of 175 hp at 2,000 rpm. They are specifically designed for use on automotive applications where there is a need for the flexibility of higher rotative speeds and the performance of higher horsepower. Features of the two engines are fully counterbalanced crankshaft, camshaft of new design, viscous-type torsional vibration damper and revised fuel pump. Both the HRBB-600 and HRBBI-600 diesels have a piston displacement of 743 cu. in., a 5½ in. bore and 6-in. stroke. These two models are supplied with standard equipment such as air cleaner, oil-bath type, electrical equipment, flywheel housing, fuel pump, fuel oil filter, lubricating oil strainer, full-flow type, thermostats and many others. **Cummins Engine Co., Inc., Columbus, Ind.**

Hydra-Lizer

A HYDRAULIC LADDER ATTACHMENT, the hydra-lizer, automatically corrects unlevel ground conditions and provides maximum safety for ladder users. Interconnected hydraulic units displace oil from one leg into the other as ladders are erected to correct differences in terrain from hillsides to stairways. By moving a foot operated valve lever the ladder can be instantly locked in any position desired. The unit is unique as it is designed to be easily attached to all types of ladders, wood or metal, straight or flared base. Telescopic steel tubing automatically adjusts to the proper width and the unit can be reused on ladders of different dimension. The hydra-lizer meets the industrial ladder user's need of a strong, lightweight, automatic ladder equalizer to be able to operate under all conditions and stand abuse. A ball and socket shoe to conform to all irregularities of terrain along with its ability to be instantly flipped up on end for ice, slippery asphalt and soft ground conditions make a combination of all the best features of ladder shoes. **Anderson Products Co., Tulare, Calif.**

Perlite Aggregate

THE USE OF PERLITE AGGregate in plaster is constantly increasing. Perlite is a non-metallic mineral whose chemical analysis is similar to that of pumice. Perlite is in reality rock air bubbles that can be produced in predetermined densities and particle sizes. Its pH is neutral, and the processing at high temperature provides positive assurance that it will be free of any deleterious or foreign matter. The inertness of perlite has been established by autoclave tests. Perlite has at least four

(Continued on page 102)

Relieving platform, which supports New York's East River Drive, rests on 72,000 creosoted piles. Wood form, pictured here, carries reinforced concrete slab.

72,000

CREOSOTED PILES SUPPORT

NEW YORK'S EAST RIVER DRIVE!

New York's East River Drive, completed in 1942, is one of the city's most impressive waterfront parkways. This Drive is about 7 miles long; in six lanes, it carries two-way high-speed traffic. For a distance of 4.5 miles, relieving platform bulkheads were built along the shore of the East River to support the highway. These relieving platforms rest on approximately 72,000 creosoted timber piles, driven offshore in water 20 to 30 feet deep.

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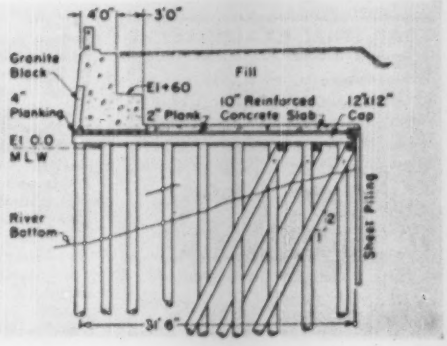

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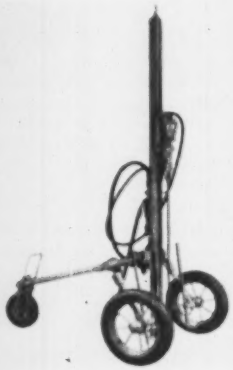
Equipment, Materials & Methods (Continued)

natural characteristics that make it outstanding for plaster aggregate. They are low density, excellent insulating properties, unusual fireproofing qualities and non-hygroscopic—it does not have an affinity for water. It will withstand more steam without cracking than sanded plaster. Low density, or lightweight, of perlite and the fact that it is not water hungry are two characteristics combined to produce a perlite plaster mortar that is less than half the weight of sand plaster mortar and, in addition, has remarkable workability. It has been established that there is a labor saving in the application of perlited plaster. In addition, plastering contractors tell us that the workmanship of the journeyman is improved due to lack of fatigue occasioned by handling the much lighter weight mortar. **Building Products Div., Great Lakes Carbon Corp., 18 E. 48 St., New York 17, N.Y.**

Light Wagon Drill

THE G-150 LIGHTWEIGHT wagon mounting, recently developed for handling sinker drills of the 55 lb class, or 3-in. drifters, is now available. Designed for increased



Model G-150

footage, in one-man operation, the G-150 features longer steel changes, newly developed feed motor, powered steel puller, positive and uniform feeding pressure and ball bearing wheels with pneumatic tires. A rotary type air motor with graduated control, worm gear transmission, and feed chain gives a steady feed with quick return and ample power for pulling tight steel. The control is such that drill will not plunge if the steel breaks. The chassis is of tubular construction and is so designed that the feed motor can be used to raise the frame from minimum to maximum height. For further information request Bulletin SP-3010. **Chicago Pneumatic Tool Co., 6 E. 44 St., New York 17, N.Y.**

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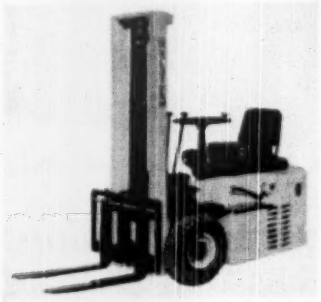
Equipment, Materials & Methods (Continued)

Lift Truck

ON THE MARKET for the first time in February will be an entirely new 2,000 lb capacity lift truck. Smallest in the company's line of seven industrial trucks, the new machine incorporates more than 70 basic improvements in design and construction. Powered by a Wisconsin air-cooled engine which can withstand great extremes in weather conditions, the truck operates at substantially lower running temperatures because of alterations in both design and installation of the engine.



Model 20

Engine accessory-improvements include a larger automotive-type battery, a redesigned muffler with spark arresting features; and a larger gasoline tank with more than sufficient capacity to permit full 8 hr work shifts without refilling. The clutch, larger than before, provides smoother control and is claimed by the manufacturer to have twice the life of any other lift truck clutch on the market. With required pedal pressure comparable to that of a passenger automobile clutch, adequate space is allowed for the driver's foot. The transmission is now heavier and more rugged in construction to meet the rough demands of industrial work. Other distinctive features of the new lift truck model include: easier steering, better braking power, lug-type pneumatic tires, and increased operator comfort through adequate foot room and an air-cushioned seat. Easy accessibility of parts for servicing is one of the major factors of design. The Model 20 may be fitted with the usual Hyster special-purpose attachments such as load-grab, paper-roll grab, scoops, booms, guards, towing hooks, etc. **Hyster Co., 2902 N.E. Clackamas St., Portland 8, Ore.**

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(Continued on page 104)

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Equipment, Materials & Methods (Continued)

vertical to horizontal. The outlet thoroughly mixes room and supply air for rapid temperature equalization and noiseless and draftless air distribution. The new Model JC is a combination supply and exhaust unit. This unit is similar in appearance to the Model J. The ceiling outlets are available in a wide range of sizes. **Electrical Div., Barber- Colman Co., Rockford, Ill.**

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(See Page 60 for Abstracts)

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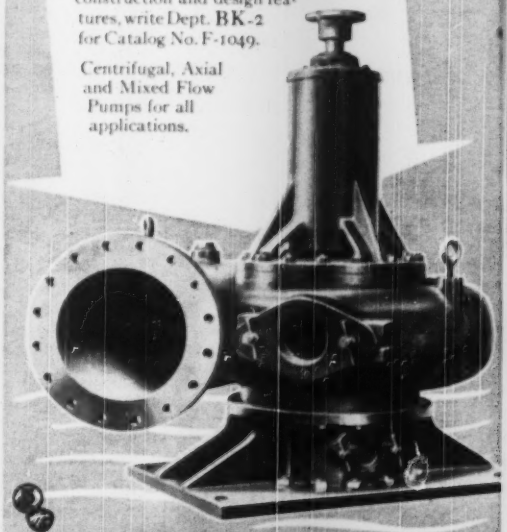

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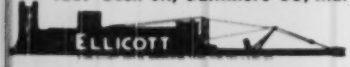

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TRENCHMOBILE—The utility size, rubber tire mounted Model 80 trenchmobile, is described in detail in an attractive 8-page catalog recently published. The catalog carries many action photographs to illustrate principal trenchmobile heavy-duty construction and its many applications in installing conduit, off-street connections, gas lines and water services, airport, railroad and golf course maintenance work. Schematic diagrams and engineering specifications are listed in addition for a concise summary of the new units design and performance. **Parsons Co., Newton, Iowa.**

SEWAGE PROCESSES & EQUIPMENT—Manual No. 149 entitled Modern Processes and Equipment for Sewage and Industrial Waste Treatment consolidates a wealth of information and experience into a concise and comprehensive 24-page book. It represents the up-to-date thinking of sanitary engineers and crystallizes the approach to modern waste treatment methods and equipment. The book graphically illustrates and describes today's most complete line, is especially arranged for quick, handy, factual reference and should help determine which process and units will most effectively answer specific waste treatment problems. **American Well Works, Aurora, Ill.**

(Continued on page 108)

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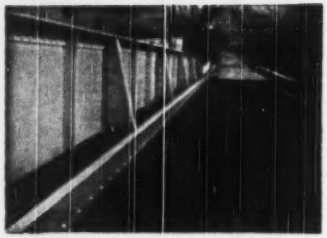

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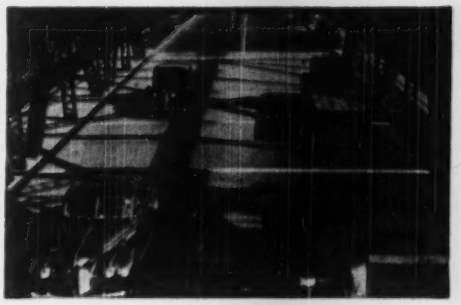

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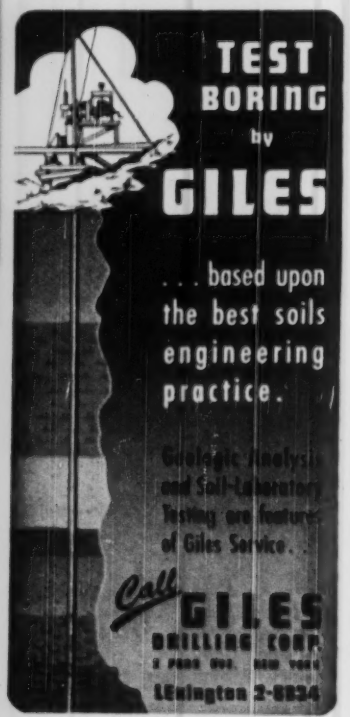

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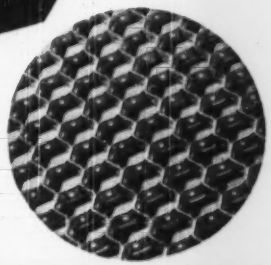

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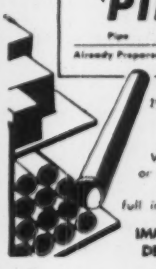

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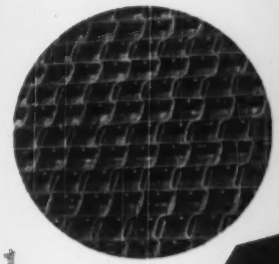

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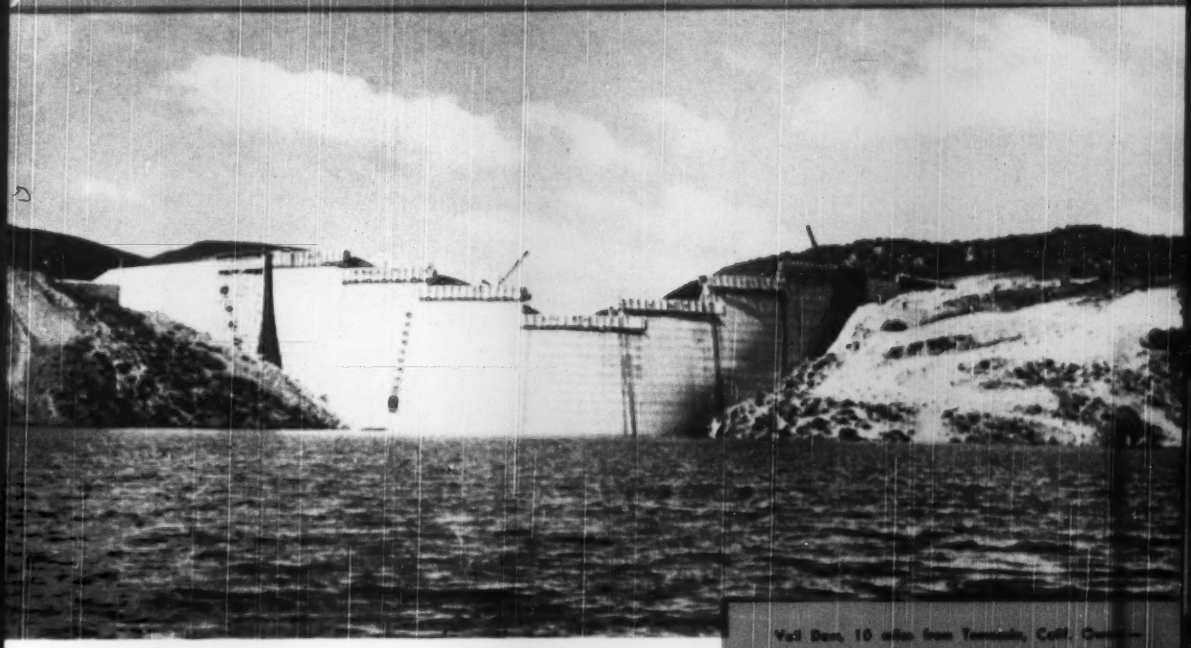
POZZOLITH CONCRETE



Vail Dam, 10 miles from Temecula, Calif. Owner—Privately Owned by Rancheros Arabi.—Private Plans Engr.—Under State Supervision; Contr.—Boyt Construction Co., Los Angeles, Calif. Built with Pozzolith Concrete.

POZZOLITH Solved Placing Problem, Produced Better Concrete, Cut Costs . . .

Difficult placing, due to the low water-cement ratio required, and aggravated by "packing" of the concrete in the buckets during transportation from mixer to forms, was slowing down work on this 1000-acre lake dam.

"Pozzolith solved this problem", reported the contractor "and produced stronger, more workable concrete with a reduced water-cement ratio which was well within specifications . . . Gain in speed and ease of dumping buckets plus the superior workability in the forms far outweighed the cost of Pozzolith."

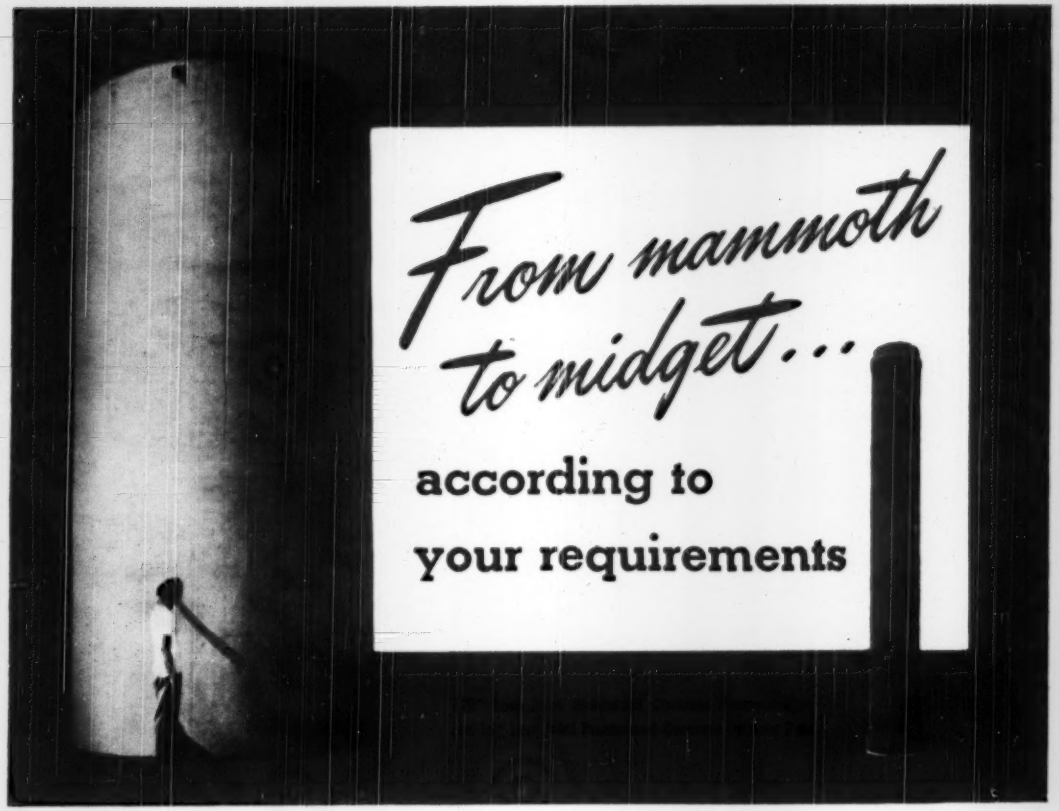
• • •

Pozzolith is the cement dispersing, water reducing admixture which makes available the optimum amount of entrained air for greater durability . . . and complies with the water-cement ratio law.

Write for full information on Pozzolith, and ACI and ASTM procedures for design, specification and production of concrete.

the MASTER BUILDERS Co.

CLEVELAND 3, OHIO TORONTO, ONTARIO

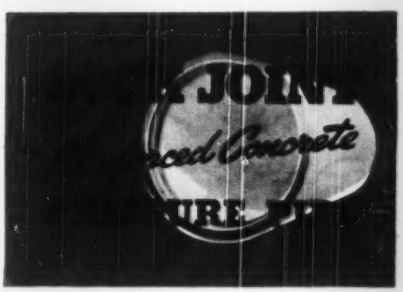


Whether your daily water consumption demands be 3,000,000 gallons or hundreds of times that figure, Lock Joint Pipe Company is prepared to provide a supply line for your requirements.

In the last few years the Company has supplied not only hundreds of miles of large diameter pipe but also more than a million feet of 16" to 24" pipe for municipalities and industry. This has been made possible through the establishment of three permanent manufacturing plants. Lock Joint Concrete Pressure Pipe from 16" to 42" in diameter, produced at these plants, can be shipped economically to all parts of the country —for both major installations and minor extensions.

Our representative will be glad to discuss with you any water supply or transmission project which calls for pressure pipe 16" in diameter or larger. You will find that Lock Joint Concrete Pressure Pipe's superior characteristics of long life, continuous high flow and negligible upkeep will recommend it above all others for any permanent water supply installation.

SCOPE OF SERVICES—Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.



LOCK JOINT PIPE COMPANY

Est. 1905

P.O. Box 969, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich.

BRANCH OFFICES: **Cheyenne, Wyo. • Denver, Col. • Kansas City, Mo. Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. • Wichita, Kan. Kenilworth, N. J. • Hartford, Conn.**